REPORT OF THE AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

APRIL 1, 1987 – MARCH 31, 1988

Ministry of Agriculture and Food

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Communications Branch, OMAF

REPORT OF THE AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

Toronto, Ontario
March 31, 1988

Mr. H. Vander Pol, Chairman
Agricultural Research Institute of Ontario

Dear Sir:

I submit herewith a report of the Ontario Ministry of Agriculture and Food's research programmes in agriculture, veterinary medicine, and consumer studies for the year ending March 31, 1988.

Respectfully submitted

J. C. Rennie
Director of Research
Agricultural Research Institute of Ontario

Blenheim, Ontario
April 1, 1988

The Honourable Jack Riddell
Minister of Agriculture and Food
Legislative Buildings
Toronto, Ontario
M7A 1A3

Dear Sir:

I have the honour to submit the twenty-sixth research *Report of the Agricultural Research Institute of Ontario* for the period April 1, 1987 to March 31, 1988.

The Institute wishes to express its sincere appreciation for the wholehearted cooperation of the administration and staff of the institutions at Alfred, Centralia, Guelph, Kemptville, New Liskeard, Ridgetown, Toronto, and Vineland in the planning and execution of research programmes in agriculture, veterinary medicine, and consumer studies.

Respectfully submitted

H. Vander Pol
Chairman
Agricultural Research Institute of Ontario

The Agricultural Research of Ontario Act passed by the Provincial legislature created the Institute in 1962 with the specific duties and responsibilities over the expenditure of the Ontario Ministry of Agriculture and Food's research funds for agriculture, veterinary medicine, and consumer studies. The ARIO meets every two months to review research programmes, to inquire into whether or not they meet the needs of the industry, and to make recommendations to the Minister, where appropriate, on the expansion or reduction of programmes and their human and physical resources.

The ARIO is composed largely of farmers and agribusiness people and its membership reflects the broadly based nature of Ontario's agricultural industry. The membership, of not more than fifteen, is appointed by the Lieutenant Governor in Council who also appoints the Director of Research from the Ministry.

Nine centres report to the ARIO: Agricultural Laboratory Services, Alfred College of Agriculture and Food Technology, Centralia College of Agricultural Technology, Economics and Policy Coordination Branch, Horticultural Research Institute of Ontario, Kemptville College of Agricultural Technology, New Liskeard College of Agricultural Technology, Ridgetown College of Agricultural Technology, and University of Guelph. The seven experimental stations, Alma, Arkell, Cambridge, Elora, Guelph, Ponsonby, and Woodstock, are managed by the University under contract with the Ministry.

Under the Act, the Institute may accept donations and grants of monies for research which are held in trust by the Director of Research and allocated for research in accordance with the terms of the funds. These funds are usually from commercial sources and are used for specific projects.

The ARIO is a unique corporate body responsible to the Minister of Agriculture and Food.

MEMBERS OF THE AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

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Dr. P. Wall, Vice-Chairman
Dr. J. C. Rennie, Director of Research
Miss M. Toivonen, Comptroller
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Dr. Y. Martel
Mr. K. G. Murray
Mr. B. Schubert
Mr. T. Smyth
Mrs. D. Whale

REPORTING INSTITUTIONS

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Guelph, Ontario
N1G 2W1

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et alimentaire d'Alfred
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Centralia College of Agricultural Technology **CCAT**
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Ontario Ministry of Agriculture and Food
801 Bay Street, 4th Floor
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Horticultural Research Institute of Ontario **HRIO**
Vineland Station, Ontario
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Kemptville College of Agricultural Technology **KCAT**
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K0G 1J0

New Liskeard College of Agricultural Technology **NLCAT**
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Ridgetown College of Agricultural Technology **RCAT**
Ridgetown, Ontario
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University of Guelph **UG**
Guelph, Ontario
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BUDGET

1987-1988 RESEARCH FUNDING	Ontario Government Funding $	ARIO Trust Fund (receipts) $
Technology & Field Services	194,250.00	78,345.85
Education & Research Division	4,646,000.00	----------
Agricultural Laboratory Services	400,000.00	----------
Economics & Policy Coordination Branch	689,303.00	----------
University of Guelph	21,400,000.00	42,735.14
Horticultural Research Institute of Ontario	4,129,000.00	140,342.11
Alfred College of Agriculture & Food Technology	152,900.00	----------
Centralia College of Agricultural Technology	217,900.00	20,010.88
Kemptville College of Agricultural Technology	1,269,300.00	92,001.81
New Liskeard College of Agricultural Technology	776,700.00	34,727.16
Ridgetown College of Agricultural Technology	2,247,600.00	112,911.35
Marketing Division	340,000.00	----------
Ontario Crop Introduction & Expansion Program	500,000.00	----------
Special ARIO Trust Funds		
Red Meat Reasearch Plan	----------	750,000.00
Ontario Pork Industry Improvement Plan	----------	800,000.00
Agriculture & Food Research Program	----------	2,000,000.00
TOTAL	**$36,962,953.00**	**$4,071,074.30**

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Research Highlights

This section outlines only a few of the projects and important results arising from research funded through the Agricultural Research Institute of Ontario. A complete listing, by institution, is given in the section, Inventory of Agricultural Research Projects.

ECONOMICS

During the past year, researchers and policy advisors of the **Economics and Policy Coordination Branch** have analyzed a number of issues most of which dealt with the matter of free trade.

In March, 1987, the results of an extensive study were published on the expected implications of the Free Trade Agreement (FTA) between Canada and the United States. This paper is the Ministry's authoritative statement on this crucial matter.

Three more papers were published on specific matters relating to the FTA: an analysis of the proposed tariff 'snap-back' provisions for fresh fruit and vegetables, a study of the impact on Canadian industries using wheat, and an assessment of the effects the Agreement will likely have.

The reports main conclusions are that: on balance, Ontario will lose $95 million dollars per year of farm income under the FTA; there would be additional costs from falling values of assets, particularly for land in the Niagara region; the fruit and vegetable producers will be hurt the most with grape growers the most adversely affected; and, the only commodity group likely to benefit is livestock and red meat.

While the agriculture and food industry will continue to need answers to questions on the FTA, researchers in the Branch will turn their attention as well to matters relating to the General Agreement on Tariffs and Trade (GATT). Discussions and the decisions based on these could have wide-reaching effects on both agriculture and food.

A study at **Ridgetown College of Agricultural Technology** concludes that because of changes in the source of risk to producers, hedging, using Chicago futures contracts, as a tool to minimize risk would likely work better in soybeans and live cattle than in hogs and corn.

Especially since 1980, risk to Ontario grain corn producers from variations in basis has grown while risk from variation in cash prices and Chicago futures' prices has remained the same. Because hedging minimizes a producer's exposure to price risk, but does not handle basis risk, it may be less useful for corn producers as a tool to minimize risk.

In soybeans, basis variation is significantly less than those in either cash or futures prices; for this crop, hedging using Chicago futures would work well.

For livestock, basis variability is greater in hogs than in cattle implying that hedging would work better for the latter. In fact, basis variation in hogs has increased sharply over the last three years surpassing both cash and futures price variation as a chief source of risk to producers.

ENGINEERING

Engineering research at **Alfred College of Agriculture and Food Technology** has concentrated on problems of draining the heavy clay soils characteristic of the area and on improved ventilation for animal housing.

Observations made in 1987-88 of mole drainage systems in the Alfred region indicate clearly that this technique is profitable for reducing the moisture content of clay soils with a hydraulic conductivity lower than 0.3 m/day. Mole drains installed two years ago are still wide open.

Testing air-flow in a naturally ventilated swine barn

A number of farmers and researchers in Eastern and Northern Ontario, other parts of Canada, and in the USA have expressed interest in the drainage system, and some full-scale farm installations were made this past summer in the Alfred area.

Work on natural ventilation systems for livestock housing covers the environmental conditions and the structural design of air inlets and ridge openings. In the past year, the main development has been a controlled strategy for both cold and moderate climates based on preliminary research on the concept of the minimum ridge. The main benefit is a 50% reduction in the cost of construction for a ridge outlet.

The project is in the final stages of the environmental and structural tests. The next two years will be devoted to working out construction guidelines.

A gravity manure transfer system has been developed to eliminate the traditional pumps or stacker which often are expensive to buy and costly to maintain. The system will work with a minimum of change in most tie-stall dairy barns with good management practices. About 50 such systems have been installed in Eastern Ontario, most of them in Glengarry and Stormont Counties. A factsheet to be published this year covers the subject in detail.

The Agricultural Engineering Services at **Kemptville College of Agricultural Technology** carries out studies on crop storage and conditioning, farm structures, drainage, and water supply. Much of the research is aimed at helping farmers get the most for their dollars, for example, by testing different hay-drying fans for airflow and cost.

One research project of particular interest deals with the application to farm problems of artificial intelligence, (or expert systems) that is, computer programmes which combine data so as to produce novel answers to complex questions. This technology, which is used for sophisticated medical diagnosis, has been modified as the basis of a system to help a farmer select a silo best suited to his or her situation. The programme is now available to extension engineers assisting farmers through county agricultural offices.

Engineering research at **Ridgetown College of Agricultural Technology** involves improved livestock housing (chiefly ventilation) and efficient grain drying systems. In the swine barn, the naturally ventilated section works satisfactorily. The installation of side curtains appears to be a good way to retrofit an existing barn for this type of ventilation.

FIELD CROPS

Eastern Ontario farmers grow a wide range of field crops including corn, oats, wheat, barley, a variety of forage legumes, and soybeans with research support from **Kemptville College of Agricultural Technology**. Forages are grown on 710,000 acres and provide the basis for the livestock economy of the region. Corn is the second largest crop at 300,000 acres.

Cereals are planted on 250,000 acres in Eastern Ontario and constitute a significant part of field crop production. In one trial on barley, the earliest of five dates for planting produced the highest yield. Planting dates for 1987 were from April 14 to May 25. In addition, no difference was found in yield between plots sprayed for broadleaf weeds and those which were not sprayed. The growth of the barley was strong enough to choke out 90% of these weeds. (This does not mean that spraying is never needed, but fields should be assessed individually.).

Trials on soft white winter wheat over four years have shown that the optimum seeding date for this crop is September 15 for Kemptville, and September 18 for Winchester. These dates are ten days later than previously thought correct. Based on these results, recommended seeding dates for Eastern Ontario will be adjusted.

At the College, intensive cereal management studies on barley and oats over the past two years have shown that the use of fungicides and/or growth regulators is not warranted under all growing conditions. A disease-resistant, strong-strawed variety planted early may not need such help. In cases where late planting, weak straw, or lack of disease tolerance in a cultivar leads to low yields, however, correctly timed use of a growth regulator or fungicide will rehabilitate the crop to some extent.

Work is now underway on reduced tillage management in corn and on the use of graminicides (grass herbicides) for better control of grasses in soybeans.

With the emphasis on conservation tillage, information is needed on how cultural practices are affected by the change in tillage methods. In 1987, the College established conservation tillage plots so that changes in weed species could be monitored and the effect of herbicides under this regime could be studied. Perennial weeds are expected to become more of a problem. Corn's response to surface application of urea will also be studied.

Along with cultivar trials for forages at the College, studies comparing the effects of different types of drainage on yields are being conducted to find ways of lowering production costs. Mole, tile, and surface drainage are all being tested with alfalfa and trefoil grown on Napanee clay.

The College's field crops programme will benefit from the purchase in 1987 of 20 additional hectares of land at the Winchester Field Station.

At **New Liskeard College of Agricultural Technology**, field crop research is mainly devoted to evaluating how adaptable certain crops are to Northern Ontario conditions. These crops include cultivars and lines of oats, wheat, and barley, of forage legumes and grasses for storage and pasture, and of oil and protein crops such as canola, field peas, flax, and short-season soybeans.

Very encouraging yields of over 7000 kg per ha were obtained during the 1987 growing season for certain barley cultivars produced under intensive cereal management (ICM). ICM is a system which has been in the process of refinement for a number of years at the College.

A recent addition to the College's research effort is the establishment of a 55-ha crop test site in the Rainy River District. Here, cereal cultivars from either eastern or western Canada are compared and production studies are carried out on forage and oilseed crops. This information will allow the farmer in Northwestern Ontario to select cultivars which are best adapted to the particular conditions in that part of the Province.

Future studies in ICM will emphasize hard red spring wheat since milling companies are interested in obtaining Ontario-grown wheat and prices are higher than for other types of the cereal. In forages, the pasture research programme will be intensified in the interests of livestock producers in the North, and since canola is already grown in Northern Ontario and the demand is good, production of this crop will be stressed.

At **Ridgetown College of Agricultural Technology**, research and variety/hybrid evaluation is carried out on cereals, corn, soybeans, and forage crops. Cooperative evaluation of cereal selections from 1984 to 1987 helped support the registration of HRS Ena soft white winter wheat from the Harrow Research Station, Imperial six-row barley from Agriculture Canada, Ste-Foy, Quebec, Craig two-row barley from W.G.Thompson & Sons Ltd., and Newman oats from Agriculture Canada, Ottawa.

Analysis of one year's data on the nitrogen requirements of hard red winter wheat cultivars Absolvent and Monopol showed that the maximum economic yield for both was obtained with 176 kg N/ha or more than twice that recommended for soft white winter wheat. At present, there are no nitrogen fertilizer recommendations for both the hard red winter and spring wheat. Research on this matter will continue for several more years.

A very important development was the registration of RCAT Alliance, the first soybean cultivar from the joint RCAT, Ontario Soya-Bean Growers Marketing Board, and University of Guelph soybean breeding programme. This cultivar should be accepted widely on the heavy clay soils in the 2950-3250 corn heat unit areas as it combines

multi-race resistance to phytophthora root rot with a tall, narrow plant profile and exceptional lodging tolerance.

In future, this programme will continue to develop improved cultivars including the possibility of ones with higher oil and meal quality, insensitivity to photoperiod, and high bottom-podding traits.

Removal of rogues (off-types) from soft white winter wheat increase blocks representing all entries in the Cooperative/ Regional Tests across Ontario for which RCAT multiplies and distributes all of the seed. *Photo by A. E. Smid*

Hybrid evaluation is central to the corn programme at Ridgetown with the College acting also as the central clearing agent for private companies wishing evaluation data on their hybrids from public research stations. In addition, in 1987, eight hybrids adapted for the Ridgetown area were compared in different populations and row widths. The optimum population was about 24,000 plants per acre with no difference found between row widths of 30 in and 38 in. These data show a gradual increase in the optimum final stand, a possible indication that, with newer genetic material, production recipes will need to be fine-tuned in future.

High lysine corn hybrids were evaluated at two locations and found to be too late maturing and too low in yield to be recommended for Ontario.

Field crops research at the **University of Guelph** ranges from conventional breeding to development of sophisticated management systems to manipulation of germplasm using the relatively new methodology of biotechnology. The laboratory work is done on campus and the majority of the field work at the Elora and Woodstock Research Stations associated with the University.

In the corn programme, studies on tillage and cropping practices provided some useful results. Preliminary results indicate that chisel plowing is better than mouldboard tillage for the surface soil structure, but reduces corn grain yield if corn follows corn. Winter wheat underseeded with red clover resulted in better soil structure than did corn, soybeans, or barley. In addition, a reduction in wheel traffic on the fields reduced soil compaction, but did not affect grain yields.

Several improved corn inbreds and hybrids were identified including G8744, a high-yielding OMAF-developed hybrid supported for federal registration. In addition, the programme yielded several improved inbreds through new mutagenesis methods.

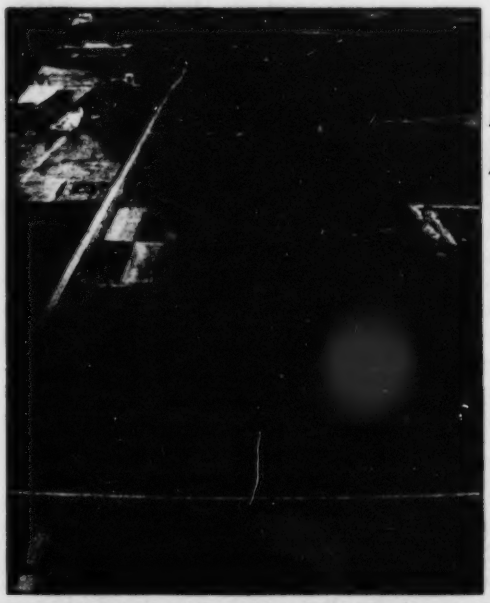
In cereals, the breeding programme resulted in registration of OAC Kippen, a spring barley with superior yields and disease resistance which will be released by SeCan. OAC Elmira winter barley was also registered and released. This variety has improved yield, winter hardiness, and disease tolerance.

The development of an improved medium for anther culture of barley, BAC3, improved the green plant recovery 20 fold and may enhance this new breeding method for this species. Anther culture is also being tried, with increasing success, for developing wheat breeding lines.

The forage programme includes breeding, quality evaluation, management, and forage utilization components. This past year, an alfalfa synthetic, OAC33-101, was selected for its superior winter hardiness. Quality evaluation studies found that silage inoculant can reduce protein degradation in ensiled forage, and that there is a poor relationship between different morphological characteristics of varieties and the quality of the forage.

Leaf-cutter bees improved the seed yields of alfalfa by two to five times. Plow-down studies indicated that red clover provides corn with the equivalent of 80-120 kg/ha nitrogen on continuous corn, but the enhancement is insignificant by the third year after the clover is plowed down.

The two best treatments in a series of pasture-management grazing trials with beef cattle resulted in about 800 lb liveweight gain over 147 days. Both treatments were of grass-legume sward. In one case, the cattle were rotated among four larger paddocks; in the second, they were rotated among 12 smaller paddocks.



A view of the extensive pasture-management project at the Elora Research Station, and below, of three occupants busy in one of the paddocks.

Photos from Dr. E. Ann Clark, Crop Science Dept., University of Guelph.

The oilseed and protein crops programme includes the development of improved soybean cultivars and management practices for soybean, winter and spring canola, field beans and peanuts. Important progress was made in a number of these.

The soybean cultivar OAC Musca was released to growers through SeCan Association and OAC Dorado was multiplied for release in the spring of this year.

The first winter canola developed in Canada, OAC Winfield was supported for Federal registration and multiplied for release this year. This variety has the highest oil content of any in Canada.

The spring canola, OAC Triumph was released in 1987 from this programme. This triazine-tolerant canola with improved agronomic and quality characteristics should replace OAC Triton (1984) in Ontario. OAC Triton was the world's first triazine-tolerant canola.

Two improved white bean varieties, one early (OAC Sprint) and the other late maturing (OAC Gryphon), were supported for Federal registration in the past year. These will be multiplied for release to Ontario seed producers in 1989. Work continues with good results in developing narrow row, upright varieties, expected to be released in 1990, and blight resistant ones.

Several improved lines of peanuts are emerging in the programme. The best of these should be registered this calendar year and released in 1989 for dramatically improved yields and quality characteristics in the Ontario crop.

FOOD AND FOOD QUALITY

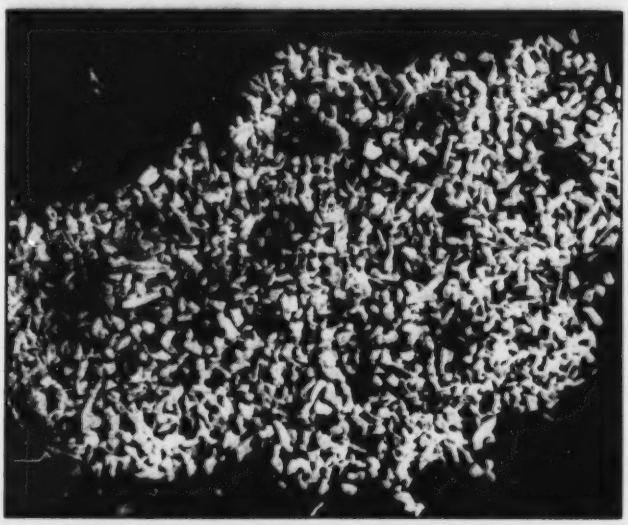
At the **Horticultural Products Laboratory, Vineland (HRIO),** researchers investigate storage, handling, processing, and quality of harvested fruits and vegetables. One important breakthrough for Ontario grape growers and processors in the past year has been the development of sparkling grape-juice products to the commercial level. This will use some of the Province's surplus grape supply while providing the public with an excellent domestic equivalent to an imported product. There are now two such products on the market under the "Vitale" and "Champanade" labels.

In storage research, a pilot study is underway to investigate the long-term storage of Spanish onions for processing. This work is an outgrowth of the Transition Crop Team's efforts to help growers diversify into crops not traditionally grown in Ontario.

Processing research at HPL has emphasized the assessment of processing potential in vegetable and fruit varieties developed at Vineland's Research Station. Now, because of the global food market, and the public's desire for high quality, convenient foods, the food industry needs research on value-added processing. Research of this nature at HPL showing considerable promise involves the development of paste from Ontario-grown tomatoes and of frozen fruit purees.

A joint project between the Food Science Department at **University of Guelph** and Protein Foods, Inc. of Hamilton resulted in the development of a means by which rennin, an enzyme used in the manufacture of Cheddar cheese, can be used repeatedly. Processed, granulated chicken bones (of which there are large quantities available at present) are used as a supporting matrix which will hold the enzyme (scarce and expensive at present). The milk is filtered through the bone/rennin combination, but the bone granules hold the rennin in place so that it can be used for another batch of milk.

This process, called "Biobones", has a number of attractive features; It uses excess chicken bones, it conserves rennin, and it makes it unnecessary to use fungal enzymes in making cheese which reduce yields and leave a poor flavour. A pilot plant-scale system has been set up at Ault Dairies in London, Ontario.



a) A sample of Biobones showing size of bone granules.
Photos from Dr. R. Yada, Food Science Dept., University of Guelph

b) Electron micrograph of granulated chicken bones shows the pores which hold the rennin during the Cheddar-making process

HORTICULTURAL CROPS

Vegetable research at the **Horticultural Experiment Station, Simcoe (HRIO)** concentrates on developing and identifying superior cultivars adapted for Ontario conditions and on management and harvesting systems which are cost effective and competitive. In the past year, a number of new cultivars have been recommended for Ontario growers: Luna and Brutus cabbage, Polar Express and Taipan cauliflower, Galaxy and Cruisar broccoli, Roadrunner muskmelon, Jupiter pepper, and Celebrity tomato.

In fresh market tomatoes, imports to the hotel, restaurant, and institutional trade are high during Ontario's production season. The 'Premium Pack' type of tomato required for this trade could be grown in Ontario and work on its management and physiology is emphasized at Simcoe. Preliminary studies based on a system used in Florida have given promising results. Since determinate plants are used, there is little or no pruning required. Yields were higher than from either bare soil plus staked plants or conventional flat culture.

Chitting or green sprouting continues to show promise as a means to increase early yield of potatoes. Seed tubers are sprouted at cool temperatures in the light to produce short, thick sprouts. On June 30, yields of chitted Jemseg and Conestoga averaged 12.2 t/ha compared to 6.7 t/ha for the controls. There is about a week advantage in emergence and yield for chitted potatoes.

Further work will define the optimum amount of chitting for a given cultivar and identify cultivars best suited for the treatment. Using chitting, growers will be able to begin replacing some of the imports of early potatoes into Canada: 45 million kg in June and July (5-year average).

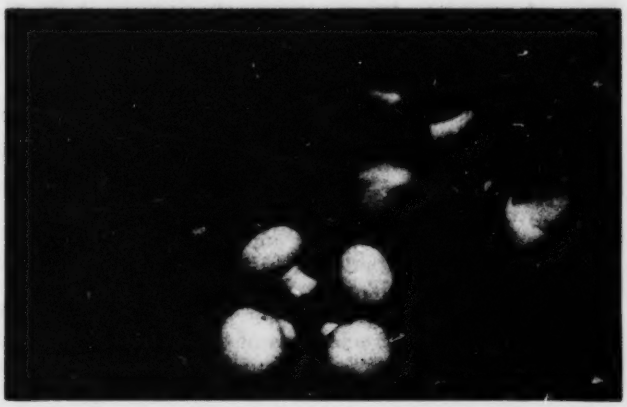
The main emphasis in management and physiology studies for the next few years will be on the physiological age of seed tubers and how this factor might be used to control potato growth. The physiological age can profoundly affect yields.

Work continues on developing new, high-yielding cultivars of asparagus with superior quality. To reduce the considerable time necessary to develop a new cultivar, an asparagus seed bed will be established at Simcoe in 1988; as new 'supermales' are developed, they will be used to pollinate superior female plants, producing substantial quantities of seed after only one year.

In the programme at HES, Simcoe to assess and develop new crops which could be profitable for Ontario growers, garlic, oriental vegetables, and jumbo onions have the best potential for expanded production. Other crops with lesser potential are salsify, leeks, and coriander. For the immediate future, stevia, a sugar substitute, and kenaf, a fibre source, will be added to the list of new crops being tested.

Research on greenhouse crops at the **Horticultural Experiment Station, Vineland (HRIO)** includes management of vegetables, fruit, and flowers for the cut-flower trade. Studies concluded in 1987 have shown that, in growing tomatoes, it is possible to save up to 45% in energy costs using double-layer acrylic as a greenhouse glazing without any loss in yields. This, along with other technologies to conserve energy which were demonstrated at Vineland, has helped the industry save over $3 million per year.

Cultural studies on new flower and vegetable crops have produced dramatic results. Commercial production of alstroemeria was unknown in Ontario three years ago; the 1988 crop will exceed $3 million. Two years ago, no greenhouse peppers were grown here; in 1988, more than four ha were planted.



Three types of mushrooms for which research is carried out at HES, Vineland Station; clockwise from the bottom, the common button mushroom (Agaricus bisporus) shiitake (Lentinus edodes), and oyster mushroom (Pleurotus ostreatus).

HES, Vineland has the only publicly funded mushroom research facility in Canada. It continues as the focal point for demonstration and dissemination of technology for the exotic mushrooms *Pleurotus* (oyster) and *Lentinus* (Shiitake). Commercial production has gone from a negligible amount to $3 million a year in the past five years. Ontario button mushroom production now exceeds $70 million a year.

Commercial nursery operators recognize the importance of the ornamentals programme at Vineland to their business and give financial support to the extensive projects on rooting, propagation, container culture, and nursery management financially supported by the industry.

In the past year, three deciduous azalea and three rhododendron varieties were released from the programme: Vinecourt Duchess, Vinecourt Jester, and Vineland Carousel; Vineblush, Vinemark, and Vinebrook.

Research on fruit at **HES, Simcoe** and **HES, Vineland (HRIO)** covers breeding and management of tree and small fruit species, and grapes for table and juice/winemaking.

Extensive breeding and cultivar evaluations for grapes, peaches, cherries, and plums over many years have had a great impact on the industry. A recently completed tree and vine census shows that the number of plantings of Vineland-developed cultivars has increased. More than 50% of new clingstone peach plantings are Vineland introductions. The grape programme has identified ten new selections and cultivars this past year that will be tested in large-scale commercial plantings. Finally, new plum introductions, notably that of Voyageur, make high quality blue plums from Ontario available in August and extend the marketing season for this fruit.

Orchard and vineyard management are integral parts of the fruit programme. Studies on intensive culture of pear have devised viable methods to bring plantings into production earlier and to produce higher yields of fruit of superior quality and size. New orchards are using these methods.

In plant nutrition, various methods of adding calcium to apples have been shown to increase the firmness of the fruit and extend storage life. This research was done in conjunction with a large growing and packing cooperative and the results are in commercial use.

Peach canker is a serious problem in orchards. Laboratory trials at Vineland have combined high technology tissue culture and plant toxin purification methods to produce seedlings with the potential to resist canker. If a commercially useful cultivar is developed, annual savings to growers would exceed $2 million.

The strawberry cultivar Settler has been released from the small fruit programme of HRIO. It produces a large, firm-fruited berry with excellent qualities for fresh market and pick-your-own operations. Together with its sister cultivar Governor Simcoe, already recognized in Southwestern Ontario, Settler is expected to improve the Ontario strawberry crop. Requests for Settler have been received from as far away as British Columbia.

Strawberry breeding is a major part of the small fruit programme. Advanced selections of both fresh market and processing cultivars are being propagated for grower trials to be carried out in the next few years. Some high quality selections have also been made already in the latest advance in strawberry breeding, the 'day-neutral' cultivars.

Emphasis has been placed recently in the apple research programme at HES, Simcoe on seeking alternatives for the growth regulator Alar which is critical to present production of McIntosh apples, but which may be removed from the market. Paclobutrazol (Cultar) has shown promise, but research in 1987 showed that Cultar's beneficial effects are only obtained from early-season applications up to about four weeks after bloom. Unfortunately, applying Cultar at this time induces fruit flattening and shortening of pedicels.

An observation in 1986 led to trials last year showing that trunk or root injury could influence the maturity of McIntosh apples and their firmness at harvest. This intriguing possibility for a non-chemical replacement for Alar has been followed up in 1988 along with the potential damaging effects of such treatments.

Research will continue on growth regulators, nitrogen fertilizing, and irrigation but at a reduced pace. Rootstock evaluation will continue as in the past, but cultivar evaluation will be a small part of the programme. Increased emphasis will be placed on orchard management in relation to fruit growth and quality and on pruning and training of high-density plantings.

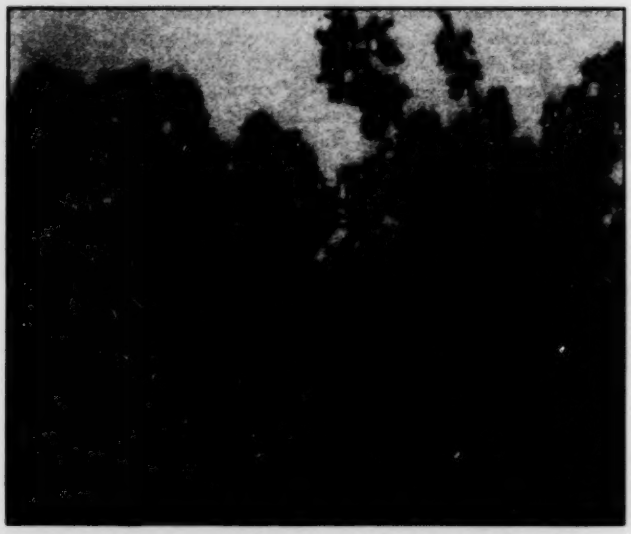
At **Kemptville College of Agricultural Technology**, vegetable and fruit crops adapted to the Eastern part of Ontario are evaluated and management systems developed. Sweet corn is one such crop which is becoming very popular in this region which produces about 31% of the Province's crop.

In the cultivar evaluations, test results from 1987 show the following: a) of standard cultivars released by KCAT, Earlivee remains the best early one for quality, flavour, and yield, Norsweet, Reward, and Seneca Horizon are excellent mid-season ones, and Norgold and FMX-178 came out as superior late cultivars; b) of the Shrunken 2 (Sh-type) cultivars, a release from Musser, 85-3161, is a 'rising star' for earliness, yield, ear size, and flavour; and c) of the Sugar Enhanced (SE-type) cultivars, Crossword (Harris), Maple Sweet (Stokes), Crystal-N-gold (Seedway), and FMX-23 (Ferry Morris) were superior.

A management trial on sweet corn showed that the planting date has a significant effect on plant vigour, yield, and ear size. The optimum date is May 14. Trials also showed that a shallower planting significantly improves earliness and yield, provided there is no moisture stress.

At one of the largest sweet corn trials (over 3 ha) in the Province of Ontario conducted at Kemptville College of Agricultural Technology, the cultivar Earlivee has shown itself still to be the earliest, at 1750 CHU, with excellent flavour.

Photo by W. J. Langenberg, KCAT



Lowbush blueberries are being developed at Kemptville College as a commercial crop. Recent success with two high-yielding clones has made the future look brighter for this popular fruit.

Cultivated lowbush blueberries are a new crop for Ontario. The 1987 season at Kemptville produced some dramatic results from the clonal research. Clones 315 and 508 had very high yield potential of 10,000 to 15 000 kg/ha coupled with good flavour. These clones greatly improve the possibilities for expanded acreages; at present, 45 acres are planted in the Province.

Horticultural research at **New Liskeard College of Agricultural Technology** concentrates on cultivar evaluation and management studies for crops adapted to the North and for some warm-season vegetables such as sweet corn which are in high demand. In addition, work done in the past few years on medicinal plants and herbs adapted

to Northern Ontario has resulted in a report published recently for producers who are interested in growing these crops.

With the present surge in interest about growing vegetables and fruit in the North, and with the establishment of a number of farmers' markets, research in future will concentrate on supporting this growing industry. In particular, the use of mulches and row covers on some warm-season vegetables will be evaluated and cultivar evaluation for crops such as raspberries and strawberries will continue.

LIVESTOCK

The mainstay of agriculture in Eastern Ontario is dairy, but Eastern Ontario also has 22% of all the beef cows in the Province. Most of the latter are in cow-calf operations.

Not surprisingly, livestock research at **Kemptville College of Agricultural Technology** has zeroed in on nutrition and management for both beef and dairy animals. A complete management package for heavy calves has been developed which has been the driving force behind an increase in production from a few hundred to 50,000 animals. Not so long ago, the birth of a Holstein bull calf was an unwelcome event. Prices and demand were both low. Today, a Holstein bull calf fetches $120 to $150 for the red veal industry. A complete package on raising dairy heifers has also been developed and a comprehensive booklet on raising replacement heifers is in the works.

Heavy calves fed a high protein blood meal with their regular diet of shelled corn and a 36% protein supplement gained one kg for every 2.98 kg of feed. Calves in the control group gained one kg per 3.24 kg of feed. The high-protein diet cuts feed costs by 20%.

Complementary work with newborn calves allows growers to switch them to a grain-based diet in three weeks. A liquorice-tasting calf starter supplemented with highly palatable compounds is fed with milk until the young animal's digestive system is ready to handle grain. This early weaning method is based on a low consumption of milk replacer and saves the farmer about $20 per animal.

Researchers have also come up with an economical ration for both beef and dairy cattle which brings about high gains and more economical milk production. On a diet of 90% high-moisture ear corn ground with the husks plus 10% liquid protein supplement, 500-lb steers gained 3.5 lb per day. With by-pass protein added, a second group gained about 3.75 lb per day. This diet could also be used for increased milk production.

In experiments with the use of Ralgro implants to improve gains - and profits, researchers found that, after 56 days, only double implants improved gains in steers over the control group. Producers, therefore, should use the double implants or reimplant steers between 56 and 84 days.

Fishmeal supplementation of alfalfa haylage in beef cattle diets was found to be effective for the first 56 days, increasing gains by 34%. Alternative, less costly, by-pass protein sources are needed to grow cattle fed on haylage.

Dairy cattle fed 4 g of zinc methionine daily during late lactation and the start of the next lactation had somatic cell counts decrease by 20% from the monitoring level even though several cows were treated for mastitis during that time. Cows not fed the zinc methionine during the same period had their SCC increase by 80%. Milk yields of cows fed zinc also were 11% higher than for the control cows.

Nutrition and management of beef and dairy cows continues to be the central concern in livestock research at the College.

New Liskeard College of Agricultural Technology carries out research on dairy and beef cattle and on sheep, a reflection of the livestock industry of Northern Ontario.

The main focus of the dairy research programme continues to be the effects of stray ('tingle') voltage on dairy cows.

Beef research is being developed to reflect the importance of the cow-calf industry in the region. One project already underway is investigating ways to increase the numbers of cows conceiving early in the breeding season and to reduce the length of the breeding and calving periods.

Sheep research is also under way at the College. The main emphasis is on evaluating the feasibility of pasture testing rams, including the identification of high growth-rate sires for pasture systems, and on the development of improved pasture systems.

At **Ridgetown College of Agricultural Technology**, research is carried out on swine and on beef and dairy cattle. Swine continues to be the main area of activity with several projects underway and new ones on the horizon. The two-tiered pens at Ridgetown allows pigs to select a preferred environment and reduces fighting. It also uses barn space more efficiently than with single-level pens. Work is continuing on the behaviour of pigs reared in this system and on improving the quality of the environment.

Work with lysine supplementation in swine diets indicates that pigs can utilize synthetic lysine effectively. The decision on whether or not to use it should be based on economic considerations rather than on improved performance alone.

Feeding research is the main emphasis in beef cattle with comparisons between alfalfa and corn silages and studies on the effectiveness of raw and roasted soybeans as energy and protein sources in feeder steers. In the dairy barns, a trial is underway using chronobiological techniques to determine the time of parturition with the idea of reducing night-time calvings.

Because of the nature of its mandate, the **Ontario Veterinary College** at the University of Guelph is concerned with research on health management of animal species in general. The emphasis, however, is on the major ones kept for man's purposes.

Dairy research at the College focuses on methods to enhance reproductive efficiency and to identify ways to diagnose, prevent, and control the main infectious diseases. An additional area of concern is the improvement of health management and monitoring programmes in herds.

One very important accomplishment has been the establishment of a centre for animal biotechnology at which a project has begun to develop biotechnological methods of embryo manipulation. The principal focus of recent work has been the development of an objective viability test for bovine embryos. It appears that platelet activating factor may be useful as a monitor of viability.

The reproductive performance of dairy cows has been shown to improve with prostaglandin therapy administered at 26 days and/or 40 days after they give birth. Studies involving uterine culture and biopsy techniques have yielded new epidemiological information on the factors responsible for post-partum reproductive pathology and impaired performance. A quantitative enzyme immunoassay for measuring milk progesterone levels has been used to study the differences in reproductive activity of cows with various abnormalities. Overall, these studies are aimed at evaluating monitoring methods for sub-optimal reproductive performance.

The effectiveness of cow-side milk progesterone tests has been evaluated, in particular their sensitivity and specificity. It is clear that these rapid-test kits should be used primarily to identify cows which are not pregnant and that the results should be interpreted with caution. Under normal conditions, some improvement can be expected in reproductive performance of herds where the kits are used, but individual cows are more likely to benefit. At present, the usefulness of these kits to improve the diagnosis of sub-estrus and cystic ovarian degeneration is being studied with the object of improving the selection of therapy.

A recently completed project on the implementation and use of a microcomputer-based herd health management system for Ontario shows promise, particularly in the use of computer-generated performance indices. A similar method of monitoring the udder health status of dairy herds is also under study.

At OVC, studies on the patho-physiology, diagnosis, and control of infectious disease continue to be emphasized. In one project, researchers have developed a new method which uses milk to identify cattle infected with the bovine leukemia virus (BLV). This test shows great promise for rapid screening of animals in BLV control programmes.

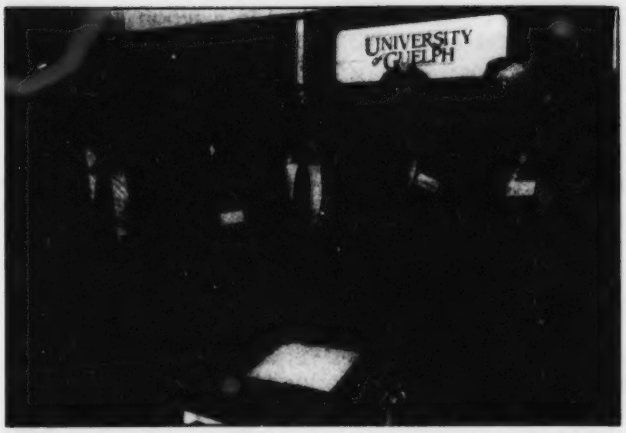
Ongoing research such as the following shows OVC's continued commitment to health problems of dairy cattle: the elucidation of the mechanisms by which *Ureaplasma diversum* causes early embryonic mortality; research on the role of bovine parvovirus as a disease agent in dairy cattle; and studies on Salmonellosis, Johnes Disease, and Coliform mastitis.

OVC has a long history of effective research in the recognition and prevention of disease in beef cattle. Over the past year, a number of projects covering a variety of subject areas have yielded results with significant benefits for the industry.

The culmination of many years of research into pneumonic pasteurellosis, or 'shipping fever', has been the development of a subunit vaccine that is likely to be marketed within a year. This disease costs the North American cattle industry up to $600 million a year in losses.

In the recently established Department of Population Medicine, the Benchmark project is well on its way to its major objectives of establishing base-line data on productivity and disease occurrence in beef herds and of identifying factors at the herd level associated with health and productivity.

Researchers who developed a subunit vaccine for the acutely fatal Thrombotic Meningoencephalitis (TME) form of the *Haemophilus somnus* complex have identified the importance of the organism in chronic pneumonia of feedlot and veal calves. Newly developed assay systems now make it possible to identify pathogenic and non-pathogenic strains and to evaluate the vaccine in preventing respiratory disease.



Celebrating the successful development of a sub-unit vaccine against pneumonic pasteurellosis, or 'shipping fever' of cattle. From left to right: Dr. Charles Povey, Langford Inc. of Guelph, Dr. Patricia Sheuen, OVC, Frank Oberle, Minister of State for Service and Technology, Dr. Bruce Wilkie, OVC, and MP Bill Winegard.
Photo courtesy of University of Guelph Illustration Services, H. Rauscher, photographer.

Sheep and goat research at OVC has made a number of important advances in the past year. Construction of the new Ponsonby Research Station sheep facilities and the funding of three major research initiatives allows for the expansion of work in these species.

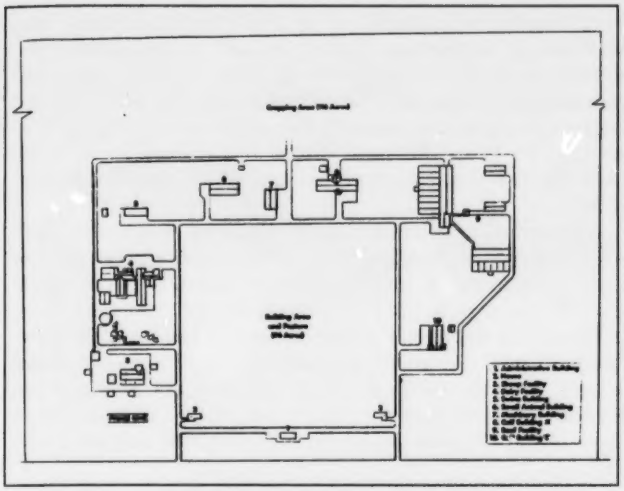
This past winter, the University's first genetically identical twin lambs were born, the products of embryo micromanipulation. (The event created considerable interest in the press.) The availability of genetic twins will be important for both researchers on campus and for producers using embryo transfer technology.

Advances were made in the diagnosis and/or prevention of a number of diseases common to sheep in Ontario: Caseous Lymphadenitis, a cause of severe under-production, Q-fever, a disease which causes abortion and has public health implications, *Chlamydia psittaci*, the cause of a group of diseases, and mycoplasmas, a cause of pneumonias and other illnesses.

The sheep was also used as a research model for a variety of disease studies which will benefit the sheep industry even though the initial focus is elsewhere: bone disease, ostogenesis imperfecta, the nervous disorder, mannosidiosis, and studies on the function of lung, digestion, and rumen.

Research on sheep is moving into integrated management studies with the funding of three new projects through the OMAF Red Meat Program. SHEPHERDS (Sheep Health and Productivity Study) is designed to identify disease and management problems in Ontario flocks by means of farm record-keeping from a sample of cooperator producers over the next two years. The second project, which is in cooperation with United Breeders of Guelph, will study ways to improve practices for on-farm artificial insemination of sheep. The third will test blood from flocks for the prevalence of selected viral diseases which could seriously affect productivity.

The completion of the Ponsonby Research Station's sheep facility will make it possible to have top-producing ewes which can be used for research into matters such as



PONSONBY RESEARCH STATION

feed utilization and reproductive efficiency. The offspring of these ewes will be of known health status and be used as valuable research animals.

Poultry research at OVC is oriented to the control of and prevention of loss from infectious diseases and others related to high production or rapid growth characteristic of modern commercial poultry. Some of the problems of high production and rapid growth are lameness, metabolic disease, respiratory ailments, and cardiovascular diseases in meat-type poultry, and poorer egg-shell quality and increased incidences of diseases in the skeleton of laying hens. Research has shown that cold increases the workload on the heart and thus leads to increased incidences of heart disease in the birds. Excess salt in the diet also increases deaths from heart disease. Broiler producers can prevent some of these problems by keeping pens at the proper temperature and making sure that the diet does not contain too much salt.

Contamination of feed with mercury, lead, and cadmium has been shown to cause kidney damage in ducks. The effect of these heavy metal poisons on egg production and quality of Leghorn chickens is being investigated as a follow-up to this finding.

Although infertility and embryo death cause significant losses to poultry breeders, research has shown that the strain of *Mycoplasma iowae* found in Ontario turkeys does not affect productivity. Work is continuing on other pathogens and on possible environmental and management causes of embryo death.

At turkey processing plants, loss from condemnation of carcasses is often high. Research has shown that much of the loss has to do with mechanical difficulties on the line, but the method of handling the live birds from farm to slaughter-house also causes injury and bruising. Further work is needed on mitigating the conditions which lead to high losses.

Research is underway on two other major fronts: improvement of vaccines for poultry, chiefly by incorporating the disease organisms which stimulate immunity into a vaccine virus which would confer immunity from several diseases at once, and the development of a laboratory technique for rapid identification of salmonella contamination in poultry.

In research to do with furbearing and laboratory animals, a number of important advances have been made over the past year. One of these involved the study of unidentifiable abortions using the mouse species *Mus caroli* to investigate the theory that some abortions are caused by the rejection of the fetus by a misdirected immune response. It appears that failed pregnancies in this species may be due to failure of the placenta, not to rejection by the immune system. These findings differ from the immune rejection theory and may be relevant to some cases of failed pregnancy in food-producing animals.

Pasteurellosis, or 'snuffles', remains an important cause of disease and death in commercial rabbitries. Antibiotics are commonly used for control. A study was conducted to ascertain the concentrations of tetracycline needed in the drinking water to get significant blood levels of the antibiotic in treated rabbits. Concentrations of tetracyline up to twice the normally recommended dosage failed to produce therapeutic levels. Based on these results, the usefulness of medicating the drinking water with tetracycline is questionable.

Sialodacryoadenitis (SDA) is an important, naturally occurring, virus infection in the laboratory rat. There is a marked reduction in epidermal growth factor (EGF) in the rat's salivary glands during the course of the disease. In view of the influence of EGF on processes such as the development of tumours and on reproductive function, infection with the SDA virus may distort the results in certain types of research carried out on laboratory rats with the disease.

Under the current five-year plan, OVC conducts research in swine aimed at solving problems which occur from conception to weaning and at increasing productivity in herds.

Of the 24 projects registered for 1987/88, eight deal with approaches to the diagnosis and treatment, or prevention, of infectious diseases from viruses or bacteria. Disease prevention is approached from two directions:

1. genetic selection for disease-resistant animals
2. identification of symptomless carriers and stimulation of resistance to disease in individual animals by immunological techniques.

Research using, miniature pigs shows that resistance to infectious diseases and reproductive performance is controlled to a great extent by genetics. These genetic factors may be manipulated in the pig population by selective breeding. The practicality of this approach needs to be evaluated further in commercial swine herds.

Although, in general, immunization against diseases caused by viruses has been successful, in the past there was no effective treatment against this type of disease. Eleven viruses pathogenic to pigs were tested for their sensitivity to the activity of two porcine interferons, anti-viral substances produced in response to infection by a virus. It was found that most of the viruses tested were either highly or moderately sensitive to one or both of the leukocyte or fibroblast interferons tested. Further work is needed to establish the clinical applicability of this approach.

In the case of bacterial disease, the main effort has gone toward identification of carrier pigs and prevention of *Actinobacillus (Haemophilus) pleuropneumonia* by improved immunization procedures. This disease is estimated to cost the Canadian swine industry $40 million annually, and neither the present serological methods for detecting carriers nor the vaccination procedures are satisfactory.

As a result of the work, an ELISA test using a purified polysacharine antigen, was developed, a purified toxin (hemolysin) was isolated, and cytotoxic-hemolytic activity of *A. pleuropneumoniae* was created. All these agents could possibly be used as improved diagnostic tools and for improving the vaccines now available.

A. Haemophilus parasuis vaccine, which was released during the summer of 1987, has been found to be very effective for preventing Glasser's disease both in experimental pigs and in the field.

The recent completion of the Equine Research Centre at OVC makes possible a wide variety of sophisticated research on problems affecting horses. In addition to offices and bench-style laboratories, there is an information centre, a meeting room available to equine groups, a laboratory for research on lameness and respiratory problems using non-invasive, nuclear medicine imaging, and a high-speed treadmill where performance-related problems can be studied.

The Hon. David Peterson, Premier of Ontario, rides in a restored road coach with its team of Belgian Warmbloods at the opening last spring of the Equine Research Centre on the grounds of the University of Guelph. Photo courtesy of the ***Guelph Mercury.***

In a project to investigate exercise-induced pulmonary haemorrhage in performing horses, detailed and repeated examinations were made of the respiratory tracts in standardbred horses which bled from the nostrils after training or simulated races. Early results indicate that many horses have inflammatory cells deep within their airways. It appears that environmental factors such as infectious agents and dusty conditions are affecting the respiratory system of the majority of race horses. Data from these tests and results after medications are used will be analyzed by the end of this year.

Several projects at the **Ontario Agricultural College,** University of Guelph, have been aimed at increasing the reproductive efficiency of swine herds. Research on feed requirements of gestating sows has shown that 1.5 kg/head/day is inadequate and leads to lower weight of piglets at birth, numbers weaned, and weaning weight. Sows fed 2.0 kg/head/day had more litters, more piglets weaned, and a longer time in the breeding herd than did those fed less or more. Overfeeding (2.5 kg) also causes problems.

A number of matters to do with the cleanliness and well-being of pigs are being studied at the University. Replacing some of the open bars between pens with solid partitions has improved the cleanliness of the pens and the pigs to a significant degree. This also reduces the labour needed to keep the pens clean and makes for a more pleasant and healthy environment for both farmer and animals.

Pig starter diets are the most expensive that the animals ever receives, and skim milk is the main reason for the high cost. Research at the University has shown that, while pigs fed skim milk grow slightly faster and use feed more efficiently at the starter phase, those not fed the milk grew faster during the growing-finishing stage. Age at market weight, average feed efficiency, and carcass quality were similar for both groups. Thus, the simple corn-soybean meal diet is as good as the expensive starter diet for growing pigs.

Housing sows in stalls has been criticized as inhumane and stressful to the animals. Research at the University, however, has shown that housing sows in groups and feeding them with an electronic system causes a lot of fighting and leads to more lameness and food problems, decreases the number of piglets per litter, and increases the time taken for sows to return to estrus by seven days. The electronic feeding system did not decrease aggression and fighting in the groups.

Extensive research is underway at the University of Guelph on parasitic mites of honeybees: the tracheal and the Varroa mites. Preliminary studies on the tracheal mites indicate that old honeybees have surface compounds that deter the migration of mites from these bees to other old ones. The compounds may be the reason that mites prefer to infest young bees.

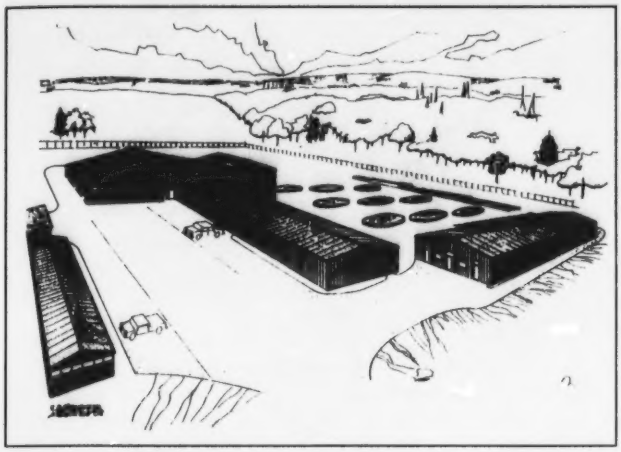
Research near Kirkland Lake has shown that honeybees are needed for proper pollination of blueberries for commercial production. There is only a small number of sparse populations of native pollinating bees in the area. For cranberries, in the Muskoka region, bumblebees are the most efficient and reliable pollinators for the three main varieties. Honeybees are needed for cranberries only in years when the bumblebee populations are low. Small hoverflies (Syrphidae) also play a small, but significant, role in pollinating this crop. There was a clear correlation among the adequacy of pollination, size of fruit, and number of seeds.

Fish-farming as a commercial venture has increased substantially in the past few years. To respond to this growth and give support to the aquaculture industry, OMAF in conjunction with the Ministry of Natural Resources (MNR), has established the **Alma Research Station.**

The Station, bought by OMAF in 1986, was previously the Creekbank Trout Farm. It needed extensive work done on site, particularly to increase the water supply and ensure that it is adequate for the research proposed. At present, the hatchery building, the one for genetics and nutrition, and the residence are completed. The quarantine building is well on its way. The hope is to stock the station with fish (for research) by late fall or early winter.

The overall site development, water conditioning building, demolition of the original farm buildings, and some other minor work on well development and storage facilities remains to be done.

The official ribbon cutting is likely to be in November,



Alma Research Station for aquaculture research: architects' drawing E. R. Broughton & Associates, Ltd.

1988 in conjunction with the OMAF IDEAS Conference, November 28-30.

The main areas of research are: improved diets for rainbow trout; nutritional requirements of rainbow trout; diseases and their control in commercially raised trout; evaluation of Tiger Trout hybrids for aquaculture; and assessment of new species for aquaculture (Ministry of Natural Resources)

PEST MANAGEMENT AND DISEASE CONTROL

At **HES, Simcoe (HRIO)**, weed research aims at efficient and cost-effective management systems for horticultural crops. This includes evaluating new candidate herbicides for possible recommendation to growers. New treatments recently registered and recommended for use during 1988 are sethoxydim (Poast) for post-emergence grass control in cucumber and garlic, trifluarlin (Treflan) for weed control in asparagus and strawberry, and napropamide (Devrinol) for weed control in tomato and several fruit crops.

Harvesting a bountiful crop of onions in the Holland Marsh north of Toronto. This crop can be damaged seriously by white rot, a disease against which a combination of fungicide, flooding, and crop rotation has been found to be successful.

Other candidate herbicides that have given good results in field trials are DPX A7881 for mustard in cole crops, clomazome (Merit) for nightshade in peppers, oxadizon (Ronstar) for broad-spectrum weed control in onions, AC 263499 (Pursuit) for weeds in peas, and DPX L5300 for weeds in snap beans. The emphasis will continue to be on developing new weed control measures, both chemical and cultural, for horticultural crops.

A new vegetable pathology research programme was begun at Simcoe in 1987 which will study the etiology, epidemiology, and control (biological, cultural, and chemical) of important diseases in Ontario crops.

Surveys of growers' fields in 1987-88 revealed that spring die-off of garlic was associated with infection by either of two pathogenic fungi, *Penicillium corymbiferum* or *Fusarium oxysporum* f. sp. *cepea*. Initial studies on this problem have shown that the isolate of *Penicillium* recovered in Ontario is exceptionally resistant to benomyl, a fungicide widely used in California to control this fungus.

Fusarium crown and root rot disease was reported for the first time in field-grown processing tomatoes at HES, Simcoe. The outbreak seems related to the use of multi-celled tray transplants grown in naturally contaminated soilless mix. The *Fusarium* pathogen establishes high populations in such mixes when introduced at the warm temperatures (25°C) normally used for transplant production. All processing cultivars examined to the present are susceptible to this disease.

Encouraging results have come from research carried out by the Muck Research Station (HRIO) in cooperation with scientists at the University of Guelph on controlling onion white rot, a serious threat to the industry in Ontario. Both micro-plots and commercial fields were used in this first successful effort in the world to control the disease. The integrated disease management system successfully combined the use of fungicides with flooding and crop rotation.

Another breakthrough was achieved, in research plots, in the control of cavity spot on carrots. Treatments with the fungicide metalaxyl reduced the disease to the point where

a high percentage of the carrots were of marketable quality. The same fungicide appears to be effective against Phythium stunt in lettuce. If approved for use in Canada, the chemical could markedly improve the marketable yields of carrots and lettuce.

The direction of muck crop research in the next few years will depend largely on the development of suitable new chemicals or non-chemical means for protection of minor hectarage crops.

In research on disease control at the **University of Guelph**, studies on chemical control of gray and pink snow mould of winter wheat show that seed treatments with the fungicide triadimenol significantly decreased the intensity of the disease and increased the yield in plots infested with the gray snow mould fungus. Pink snow mould was not suppressed by any of the seed treatments tested. An analysis of the relationship between the severity of the snow mould and the yield of wheat indicated there was a stronger relationship between the area under the crop recovery curve and yield than between the initial intensity of the disease and yield. Triadimenol is a simple, economic means of controlling gray snow mould.

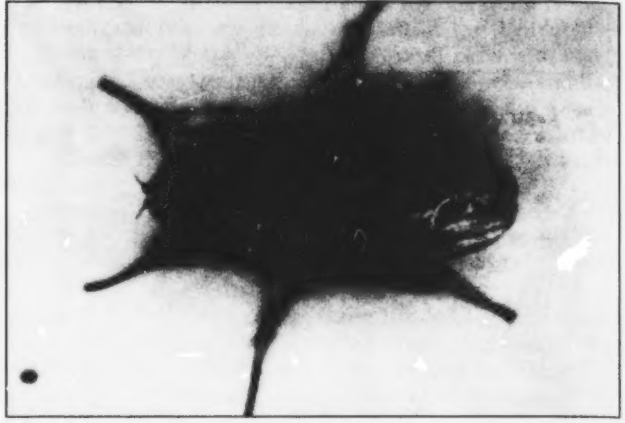
New, practical methods were developed for managing gray mould fruit rot based on year-round observations of the causal fungus, *Botrytis cinerea* in strawberry fields and field plots. Bravo (Chlorothalonil) or other fungicide(s) of similar effectiveness is applied to the green and dead leaves in October and in April or early May, before blossoming begins. These methods have advantages over conventional practices: there are no fungicide residues in the fruit at harvest; less fungicide is used, which may lower costs and would reduce the amount of pesticide in the environment; there are alternatives for benomyl and iprodione, to which *B. cinerea* becomes resistant; and the work load is reduced and distributed better over the year since fungicide applications are not needed during the busy blossoming and fruiting season.

A particularly important development from a project on disease management practices for improved productivity of winter wheat was an intensive, two-day course, "Science of Disease and Insect Management: Field Crops" given in December, 1987. The course covered a broad spectrum of topics including recognition and epidemiology of the main diseases of winter and spring wheats, impact of tillage practices and crop sequences on growth, productivity, and diseases of winter wheat, and integrated disease management.

There have been a number of important advances in insect control in the past year at the University. In one study, the application of granulosis virus of codling moth (CPGV) to plots of apple trees in the Guelph research orchard significantly reduced deep-entry damage to apples by the codling moth, *Cydia pomonella* when these were compared with untreated plots. Shallow-entry damage, however, was as great or greater in the virus-treated plots. The apples were better protected when CPGV was applied at least three times during each of the two annual generations of the moth compared to less frequent applications.

Granulosis virus of codling moth has been used widely in Europe and North America on an experimental basis. It is likely that it will be registered in the future for control of the moth and at that time recommendations on its use for Ontario can be made from this research.

Excellent progress has been made in clarifying the taxonomic status of decay-related dipteran flies. Decomposer insect communities affect agro-ecosystems in several ways in addition to their most important role of catalyzing a major step in energy flow through the system. Such communities give rise to several pests and disease vectors such as the stable and house flies.



The common house fly, the last major arthropod pest of livestock housing which requires open spray systems for control.

Manipulation of these communities should be an important factor in waste management, and indeed a control program suggested as a result of this study, using a wingless fly to compete with houseflies in poultry manure, has been successfully implemented in France. New knowledge of the decomposer community also affects other areas of agriculture such as field storage of large, round hay bales. Before this study, comprehension of decomposer communities was hindered by an inability to even identify most of the species involved.

House flies, ubiquitous pests in all livestock housing, are the last major arthropod pest requiring open spray systems for control. Examination of the various types of manure systems, belt-liquid and shallow and deep pits, has revealed that the main house-fly problems exist in deep pits where manure accumulates for from six months to one year. The high moisture content of the manure caused by the lack of air flow is a very important factor in the high numbers of flies produced. Installation of air bags to increase ventilation in the pits reduces these numbers by over 50%. An important reason for this reduction may be the dramatic increase in populations of predator beetles in well-ventilated facilities.

Corn rootworm is a major pest of field corn in Ontario which reduces yields and increases costs because of the insecticide required to control it. An important advance has been made in determining the economic thresholds of controlling the rootworm.

About 20 fields were monitored for adults each year from 1985 to 1987, and evaluated for economic return from insecticide on the following crop. These data have shown consistently that, when there is less than one beetle per plant in cornfields during August, there is no damage the following year. This economic threshold is now being used by OMAF in the Pilot IPM Program for making decisions about treating cornfields in the second year of production.

Two ongoing projects of considerable importance for the future of Ontario agriculture are devoted to the rearing and study of four specie of *Trichogramma*, egg parasites of lepidopterous insects and to the evaluation of pesticides,

for use on small-acreage crops, for registration by the Federal government.

A cooperative project is being developed, from the University of Guelph's programme to rear *Trichogramma*, among the Universities of Guelph and Toronto and Ciba-Geigy to evaluate the potential of these parasites to control pests of agriculture and forestry.

For the programme of pesticides on small-acreage crops, the main crops involved are cabbage, Brussel sprouts, strawberries, leafy vegetables, and greenhouse crops. The Provincial Pesticide Residue Testing Laboratory will conduct residue evaluations for the crops tested and these data will be available to the pesticide industry and registration officials.

The weed control programme at **Ridgetown College of Agricultural Technology** is a crucial aspect of the research effort in field and horticultural crops. A number of important control measures have been developed and/or tested in the past year.

Weed control in conservation tillage is one of the most significant factors in the success or failure of these systems; no-till is the most demanding system in this regard. Preliminary evaluations of individual herbicides, tank mixes of these chemicals, and herbicide programmes, primarily tested on no-till and ridge-till cropping systems, gave the following results: a) glyphosate and clay-based formulations of residual herbicides such as atrazine and metribuzin are antagonistic; b) Dicamba at 0.6 kg ai/ha applied in the fall controls the red clover cover crop better than 2,4-D at 1.0 kg ai/ha; c) Fall burn of dense vegetation appears to have definite advantages over spring burn; d) a combination of residual herbicides plus oil gives a good burn and residual control when vegetation is moderate to light, consisting mostly of annual weeds; e) residual herbicides plus oil as an additive work better than residual herbicides plus oil concentrates.

Eastern black nightshade can be a serious problem for farmers who grow processing peas. At harvest time as well, the nightshade may have developed its seeds which are similar to the peas in size and cannot be mechanically separated. Research at the College indicates that the currently recommended herbicides prometryne (Gesagard) and

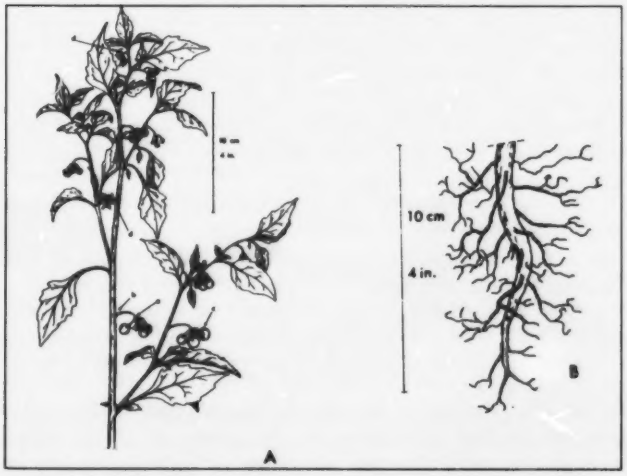


Figure 121, Black nightshade
A. Upper part of plant. B. Portion of annual root system.
From: Alex, J. F. and Switzer, C. M. ***Ontario Weeds.***
Ontario Ministry of Agriculture and Food.

Dinoseb (Dinoseb 500 PTK) are very effective in controlling this weed. Two experimental ones, FMC 57020 (Merit) and AC263,499 (Pursuit) also control it well.

Bentazon plus oil concentrate (Basagran + Assist) is the only post-emergence herbicide treatment recommended for use in soybeans to control a wide range of broadleaf weeds and yellow nutsedge. The timing of application is critical and growers often miss this. Because of this, they have been tempted to add low rates of 2,4-D, 2,4-DB and/or nitrogen to the recommended treatment to enhance the action of the herbicides on more advanced weeds which are difficult to control.

Research at Ridgetown and elsewhere has shown that the addition of low levels of 2,4-D (2 oz/acre) to the spray solution increases crop injury and does not improve weed control. Reducing the rates of bentazon or eliminating the oil concentrate when using these additives also gives lower levels of control. The addition of 28% N solution (10 l/ha) to the spray solution appears to improve control slightly.

A number of herbicides and formulations for field corn were tested in the past several years. Two appear promising against velvetleaf, a difficult weed to control and a number of other common annual weeds: SC0774 and SC0735 applied pre-emergence and pre-plant incorporated together with atrazine. A new acetanilid, San 582 + atrazine applied ppi was also very promising in this regard.

FMC 57020 (Merit) was tested on corn in combination with atrazine and metolachlor. There was no reduction in yield and velvetleaf was well controlled. In addition, a new formulation of metolachlor (Dual) containing a safener appears as effective as the former one and safer to the crop.

Successful refinement in the use of metribuzin (Sencor or Lexone) on tomatoes is one of the positive aspects of the weed control programme. Using this herbicide at low rates, mixed with the first two fungicide sprays and following a pre-plant incorporated application of trifluarlin (Treflan, Rival, Triflurex) and metribuzin, gave excellent weed control and good season-long control with good crop tolerance and no pesticide interactions.

Future research in this crop involves the integration of a good weed management system with a complete production system. This is needed because of the costs of weed control and harvesting relative to the yield potential, and the need to maintain high crop quality.

Initial experiments at the College in weed control in established orchards of apples, cherries, and peaches showed that there is an advantage in reducing herbicide rates in each application and applying herbicides twice each season. This treatment reduced the pesticide load and gave more consistent long-season weed control. Terbacil (Simbar) was the single most effective herbicide. Other effective combinations included simazine (Princep) plus metolachlor (Dual), ethalfluralin (Edge) + metribuzin (Sencor, Lexone), or simazine (Princep) pre-plant incorporated followed by graminicides such as sethoxydim (Poast), fluazifop-butyl (Fusilade), or DPX-Y 6202 (Assure).

The following herbicides gave excellent control for velvetleaf: FMC 57020 or clomazome (Merit) ppi, SC0735 pre, dicamba + atrazine, pre or post, and San 825 and 582, ppi and pre.

Disease control research at Ridgetown has led to important findings for corn leaf rust in sweet corn and foliage and pod blight in chickpeas.

Mid to late season sweet corn has suffered yield and quality losses in the past three years because of leaf rust. An evaluation of the commercial cultivars indicated that all but a few are susceptible to this disease. The relative effectiveness of foliar fungicides that could eventually be registered for use on this crop in Ontario was tested. The combination of Dithane M45 and Tilt 250EC gave the highest level of control followed by Bravo 90DG, Dithane M45, and Manzate 200. In a comparison of the weathering, or rain fastness, characteristics, Bravo 90DG was superior to Dithane M45.

One aspect of chickpea production under investigation is the need for pest control particularly of folar and pod diseases. Bravo 500, Ronilan 500 FL, and Rovral 50WP reduced the Alternaria sp., Botrytis cinerea, and Phomopsis sp. disease complex affecting chickpeas. The timing of application for these fungicides is critical and results suggest that the most effective time is between July 22 and August 10.

At present, insecticides are applied at planting for prophylactic control of corn rootworms, since it is impossible to predict an infestation with economic ramifications. About 35% of the 890,000 ha of field corn in Ontario was treated thus in 1987. The odds of having an economically significant infestation are about one in five (years), so it is conceivable that 80% of the 311 500 ha treated did not need it; growers could have saved up to $9 million by not using the insecticide.

Recent work at Ridgetown has shown that the insecticide can be applied later in the growing season for satisfactory control. Although application rates cannot be lowered later in the season, these 'layby' applications can be done during cultivation or up to six weeks after planting. They can be useful as a rescue treatment if a problem develops in fields where the insecticide was not applied at planting. It would be more useful and cost effective, however, if one could predict a rootworm infestation and apply the pesticide later only if it is needed.

Work is underway at the College to develop these layby applications further. More importantly, efforts are directed to developing decision-making tools so growers can alert themselves to possible rootworm problems before they plant. Using a day-degree system and tying this to corn heat units, it is hoped that an egg hatch prediction model will be developed. Several methods of detecting either corn plant stress or the presence of young larvae are under evaluation. Mass rearing of corn rootworms recently became possible at Ridgetown so that the large number of test insects needed for these types of studies will be available.

SOIL, WATER, AND WASTE MANAGEMENT

It is an established fact that ploughdown legumes or manure will supply residual nitrogen to crops. In 1982, **Kemptville College of Agricultural Technology** began a study to look at such residual nitrogen. Four rates of N were applied to a corn crop over the next five years ranging from 0 to 180 kg/ha. In 1987, seven rates of N were applied to each block.

The corn responded differently to added nitrogen according to previous fertilizer history. The least response was on corn to which 180 kg N had been applied in previous years. The greatest was where no N had been applied before. Thus, it is clear that rates of nitrogen needed on a crop in one year are influenced by the fertilizer history of the land in question.

At **Ridgetown College of Agricultural Technology**. researchers have been investigating the effects of different methods of soil tillage on yields of corn and soybeans in Southwestern Ontario. Results over the past four years show that there is little statistically significant difference in yields of either crop regardless of tillage system.

One notable exception is the use of spring mouldboard plowing on poorly drained clay soils. If the field is not plowed with the mouldboard in the fall, research indicates that disking crop residues and planting will give higher yields than mouldboard plowing in spring before planting.

Reduced tillage may reduce farm costs and maintain or improve soil structure and fertility for future generations. Continuing research on tillage will help provide farmers with the information needed to choose the best tillage system and to maximize profits.

At the **University of Guelph,** red clover has been studied as a ploughdown crop. This widely adaptable legume has long been favoured for underseeding cereals, but can be established under corn as well if the herbicide Eradicane is used.

Evaluations have been done on the use of red clover in three cropping systems. The first is a continuous grain corn one where the clover is re-established each year in the main crop. The second is a silage system for dairy or beef operations where silage corn is an energy source in the livestock ration and red clover silage is the protein source. The clover is planted in the corn in alternate years. The third is a cash-crop system alternating corn and barley with the clover established each year under both crops.

Red clover can be satisfactorily established in corn for the corn-hay rotation since the use of the clover as a hay or silage allows it to have a maximum effect on soil tilth. Similar tilth to that found with red clover hay can be obtained from red clover ploughdown established under barley. Red clover under a cereal also improved tilth and/or the amount of nitrogen in the soil; this, in turn, contributes to higher corn yields than those from red clover ploughdown under corn.

A new technique to characterize the stability of soil structure under wet conditions has been developed. This involves simultaneous measurement of the stability of soil aggregates and the amount of clay dispersed when soil is exposed to a standard energy input. The new method correlates well with existing ones, is faster, and is sensitive to changes in structural stability arising from changes in cropping practices.

Work was done on determining the maximum corn yield obtainable with the soil and climatic regime at the Elora Research Station and the influence of different levels of plant nutrients on the maximum yield. Several corn hybrids were grown in an outdoor hydroponic system which eliminated any below-ground (soil) limitations. The same hybrids were grown in soil plots with different levels of

fertility and a trickle irrigation system. The soil plots were included to show the extent to which factors in the soil environment, other than fertility and moisture level, limit corn yield.

Yields reached in soil with adequate moisture and fertilizer were 10% to 20% lower than the potential yield of adapted hybrids in the above-ground plots. The source of nitrogen may be the cause of this difference. Increasing the phosphorous concentration in plants during the early growth, up to the six-leaf stage, to values greater than normally reached with recommended fertilizer application can give a 15% yield increase. The extent of this varies among hybrids.

One important, but unexpected, conclusion of the study was that the weather during the growing season is the main determinant of yields. There does not appear to be an interaction between response to management practices and weather.

Precipitation separates at the soil surface into runoff and infiltration. Thus, measurements of the hydraulic properties controlling infiltration at the surface are very important. A new technique to characterize infiltration has been developed using the Guelph Infiltrometer.

A simplified model for the dispersion of solutes during infiltration has also been developed. This model can be applied to field conditions and helps clarify the movement of solutes such as nitrogen compounds or pesticides.

Summer dry spells in some areas of Southern Ontario in the past decade have increased interest in supplemental irrigation. Field studies conducted in a 2500 heat unit area indicate that yield increases from irrigation are directly proportional to water applied in mid summer and the intensity of the dry weather. Yields of corn increased with plant density in four of the five years and were usually consistent over a number of irrigation levels. Additional nitrogen above the recommended rate increased yields in two of the five years; in those two years, irrigation usually increased the response which was greatest at high plant density and with the long season hybrids.

A model has been developed to estimate corn yields for different soil moisture regimes in order to simulate crop response for various irrigation/management/season scenarios. It has been tested against data collected in the above study and is reasonably accurate. A new computer programme has been developed for scheduling irrigation on potatoes. The model is 'user-friendly' and is on a trial basis providing growers with information each week on soil water status and irrigation needs.

In agrometeorology, the importance of monitoring the concentration of trace gases, such as nitrogen oxides, NH3, CH4, 03, and S02, in an atmosphere has been recognized for several years. These gases affect crop response, but since their number is large and their concentrations usually very small, progress in this area has been slow. In many cases, not only the concentrations, but also the flux densities are needed. Until recently, it has been impossible to measure the latter for many gases. Diode lasers as tunable infra-red sources appear to offer an attractive solution to this problem and could make a significant contribution to Ontario agriculture.

TOXICOLOGY

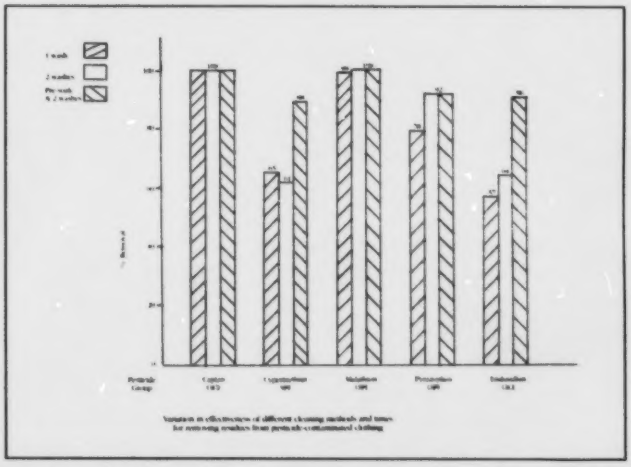
Studies carried out at the pesticide laboratory of the **Agricultural Laboratory Services** on the effectiveness of laundering coveralls contaminated with pesticides have shown that there are marked differences for different pesticides. In the preliminary test, pesticides were chosen according to the chemical group they belonged to: organophosphorous insecticide, organochlorine insecticide, synthetic pyrethroid insecticide, or organochlorine fungicide. Except for captan and malathion for which one wash removed 100% and 99% respectively, a pre-soak and two washes were necessary to remove 88% to 100% of the residue. Alternate laundering procedures will be investigated for other pesticides.

More information is needed on the fate of pesticides in the environment. The results of two studies of this nature carried out at the laboratory are as follows:

1. a study carried out with onion growers to determine how quickly oxyfluorfen (Goal [R]) disappeared from treated onion plants and soil. Residues of 1.2 ppm were found on the day of application and by day 6, these had declined to less than 0.05 ppm. The half-residue-disappearance times were calculated at 1.1 days on onions and 80 to 100 days in organic soils. The data showed that people can enter treated fields in five to six days after application without special protection.

2. a study of pesticide contamination in wells was conducted on 181 wells selected at random across 20 counties and 65 townships. No wells had residues above the Interim Maximum Acceptable Concentrations (IMAC) for drinking water, but 14, or 7.7%, were contaminated. In 13 wells (7.2%), atrazine was present at levels from 0.2 to 52 ppb, while metolachlor was present in three (1.7%) at residues from 0.8 to 43 ppt and diazinon in one at 0.1 ppb. In four cases of contamination, growers had not used atrazine in the year the sampling was done.

Studies into the degradation of both atrazine and meto-



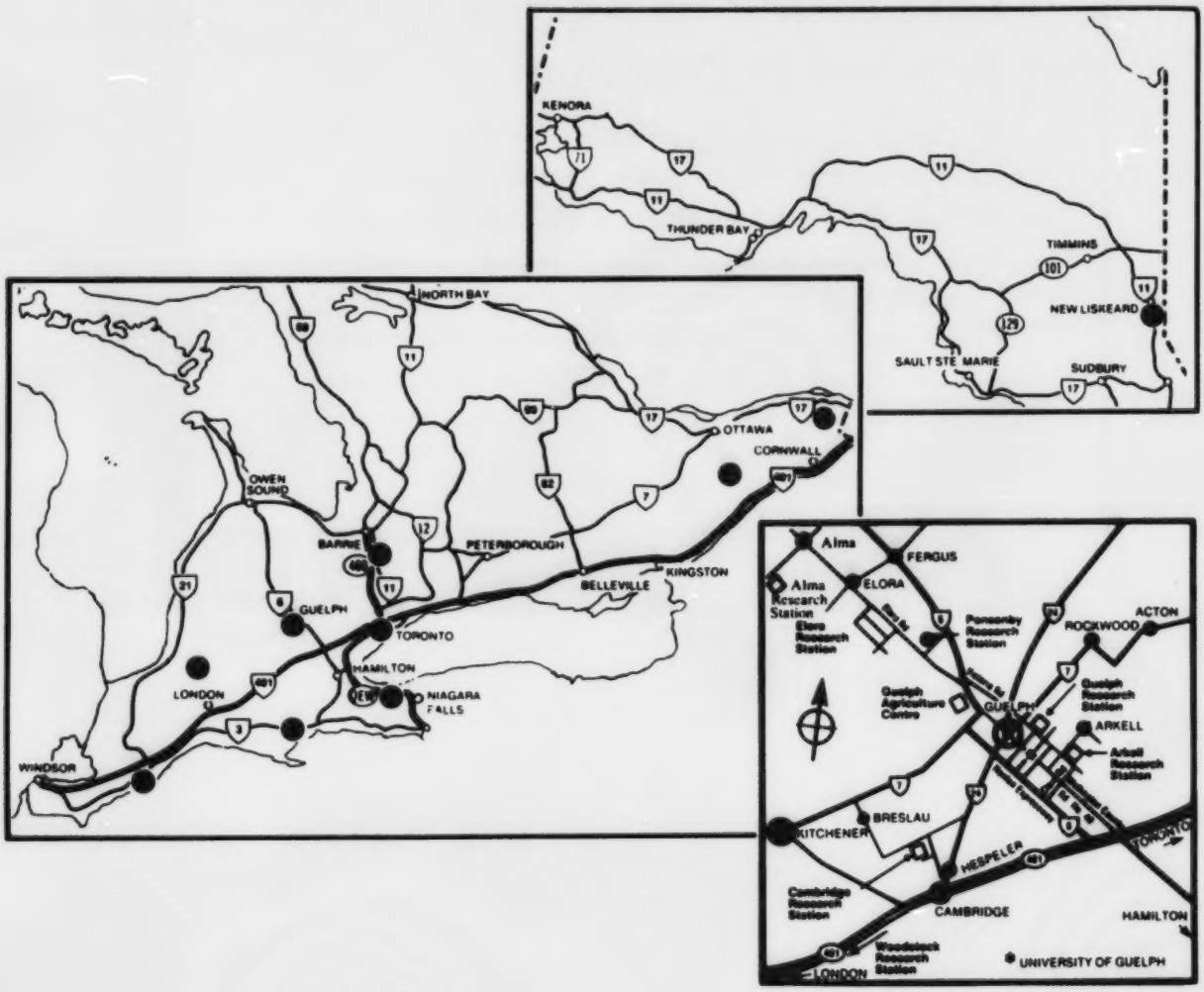
Variation in effectiveness of different cleaning methods and times for removing residues from pesticide-contaminated clothing.

lachlor in well water indicated little or no breakdown over one year. Hence, a contamination two to three years ago could still be unchanged if no action was taken to clean up the well. This has serious implications for people with dug wells which are in or adjacent to treated fields where there could be runoff or leaching or with drilled and dug wells from which water is drawn without precautions taken against back-siphoning and spills around and into the well. These problems do not correct themselves and must be recognized and dealt with.

Inventory of Agricultural Research Projects

The inventory of agricultural research projects contains all projects that were active during the fiscal year 1987-88. All those listed were funded completely or in part by the Ontario Ministry of Agriculture and Food. Those at the University of Guelph are carried out under an agreement with the Ministry.

INVENTORY OF AGRICULTURAL RESEARCH PROJECTS



1. Centralia College of Agricultural Technology
2. Horticultural Research Institute of Ontario, Vineland Station
3. Horticultural Experiment Station, Simcoe
4. Muck Research Station, Bradford
5. Kemptville College of Agricultural Technology
6. New Liskeard College of Agricultural Technology
7. Ridgetown College of Agricultural Technolgoy
8. University of Guelph, and Agricultural Laboratory Services (OMAF)
9. Economics and Policy Coordination Branch (OMAF, Toronto)
10. Alfred College of Agriculture and Food Techology

AGRICULTURAL LABORATORY SERVICES

The Provincial Pesticide Residue Testing Laboratory is one of three sections of Agricultural Laboratory Services. The research objectives are to improve and amend pesticide registrations and recommendations in order to reduce residues below the negligible level of 0.1 mg/kg whenever possible. The physical dispersal, chemical breakdown, and microbiological degradation of pesticides and toxic metabolites are monitored to set pre-harvest intervals for application of the chemicals. This research adds to our general understanding of the fate of pesticides in the environment and in food.

Studies on the hazards of re-entry into treated areas help minimize the risks in using pesticides. This research includes monitoring the exposure, absorption, and excretion of pesticides of those who use them and studying the effect of laundering clothing to help minimize the risk of applying these chemicals.

PROJECT TITLE	RESEARCHER
LIVESTOCK	
Translocation of topically applied synthetic pyrethroid insecticide on bovine	Surgeoner, Braun
Insecticides in bees and pollen	Braun, Kevan, Ripley
ENGINEERING	
Analytical method and development for new fungicides and herbicides	Ripley, Clegg
Modelling pesticide dissipation	Ripley, Braun, Ritcey, Frank
FIELD CROPS	
Monitoring flue-cured tobacco and soils on 34 farms for pesticide residues and metal contents.	Frank, Braun, Ripley, Clegg, Suda, Zilkey
Disappearance of fungicide from cereals	Ripley, Frank
FOOD AND FOOD QUALITY	
Monitoring animal tissues for pesticide residues and metals	Frank, Braun, Luyken
Monitoring Ontario grown fruit and vegetables for pesticide residues	Frank, Braun, Ripley, Wheeler
Monitoring alcoholic beverages for ethyl carbamate	Clegg, Ripley, Braun
Research into formation of ethyl carbamate	Clegg, Wright, Geisbrecht
Monitoring Ontario-consumed food for PCDD and PCDF	Frank, Thorpe
Method development for drugs including sulfathiazole in honey	Chapman, Ripley, Braun, Clegg
Researching raw and processed vegetables	Frank, Braun, Ripley

PROJECT TITLE	RESEARCHER
HORTICULTURAL CROPS	
Dissipation of pyrethroids from muck crops	Braun, McEwen, Frank
Dissipation of insecticide residues from minor crops, asparagus, carrots, eggplant, pepper, garlic, onions, tomatoes	Frank, Braun, McEwen
Daminozide and paclobutrazole residue disappearance in apples	Ripley
Dissipation of herbicide residues from onions and organic soils	Clegg, Frank
Dissipation of fungicide residues from minor crops - celery, lettuce, strawberries	Ripley, Ritcey
Studies on pesticides for minor crop registrations	Frank, Ripley, Braun, Clegg
Fungicides for protection of carrots against storage rots	Ripley, Edgington, MacDonald
Iprodione residues in fruit and vegetable production	Ripley, May & Baker Canada, Inc.
Insecticide residues in greenhouse flowers	Frank, Braun
HUMAN EXPOSURE	
Following the changes in organochlorine residues in Ontario residents over the decade	Frank, Braun
Studies on laundering clothing	Frank, Braun, Ritcey
Re-entry into treated crops	Braun, Ripley, Ritcey Frank
Exposure on re-entry	Ripley, Ritcey, Frank Clegg
SOIL, WATER, AND WASTE MANAGEMENT	
Metolachlor dissipation in the field	Clegg, Frank, Patni
Monitoring shallow and deep wells for pesticides	Frank, Braun, Ripley, Clegg
Monitoring surface water for pesticides	Frank, Braun, Clegg, Ripley
Stability of pesticides in water	Clegg, Ripley, Frank, Chapman

ALFRED COLLEGE OF AGRICULTURE AND FOOD TECHNOLOGY/ COLLEGE DE TECHNOLOGIE AGRICOLE ET ALIMENTAIRE D'ALFRED

Alfred College is located 65 km east of Ottawa on the Trans-Canada Highway, #17. It is in the heart of the highest concentration of francophones in the Province and French is the language of administration and teaching at the College. It is also in one of the main milk-producing regions of Ontario where soils for the most part are of very productive clays; by their very nature, however, they are poorly drained.

Research began at the ACAFT in 1983 with a project to resolve drainage problems in this clay soil. In the fall of 1985, another was begun to evaluate the use of mole drains in combination with 'French' drains. This research has been quite successful and further work is underway.

Another project involves the improvement of designs for natural ventilation systems and to compare natural and mechanical ventilation of swine barns. In livestock feeds, interesting work has been undertaken to evaluate the use of near infrared equipment for analysing nutrients.

The College has crop demonstration plots, begun in 1984, and a maple bush in which demonstrations are given. Last year, the purchase of an additional 60 hectares brought the land base to 150 hectares.

PROJECT TITLE	RESEARCHER
ENGINEERING	
Mole drainage	Weil, Natho-Jina
Drainage of heavy clay soils in Prescott and Russell counties	Weil, Natho-Jina
Natural ventilation for livestock housing	Choinière, Desmarais

CENTRALIA COLLEGE OF AGRICULTURAL TECHNOLOGY

Centralia College is in the heart of Western Ontario's diverse agricultural region. In agronomy, researchers test new practices in production, such as different row widths and planting dates and the use of crop rotations and plowdown legumes, for white and coloured beans, soybeans for human and animal consumption, canola, and rutabagas. New varieties are tested for traits such as their yield potential, and pesticide screening trials are held. These data are used in selecting varieties and pesticides for registration and are the basis for Ministry production recommendations. Development continues at the new Agronomy Research Farm at Cedar Springs and the Agronomy laboratory has recently been completed.

Engineers at Centralia are studying the structural load characteristics of bottom-unloading tower silos and the efficacy of a number of different coatings for the inside of silo walls to prevent structural deterioration. Other projects now underway include an extensive study of water quality in the Parkhill Creek Watershed and development of a method for scheduling the irrigation of potatoes.

PROJECT TITLE	RESEARCHER
ECONOMICS	
A standard method, procedure, and language for farm business analysis	Stephens
ENGINEERING	
Concrete tower silo coatings	Bellman
Pressures in bottom-loading silos	Bellman
Extent and causes of water quality problems in the Parkhill Creek watershed	Brunke
FIELD CROPS	
White bean and kidney bean management	Forrest
Corn variety trials	O'Toole
Soybean variety and production management trials	Forrest
Spring and winter canola variety trials	Forrest
Spring and winter canola management trials	Forrest
HORTICULTURAL CROPS	
Rutabaga production and management	Brolley
PEST MANAGEMENT AND DISEASE CONTROL	
Weed control in canola	O'Toole
Weed control in field beans	O'Toole
Weed control in corn	O'Toole
Pest control in rutabagas	Brolley
Disease control in white beans	Forrest
Insect control in white beans	O'Toole
SOIL , WATER, AND WASTE MANAGEMENT	
Evaluation of plowdown species in spring grain and corn	Forrest

ECONOMICS AND POLICY COORDINATION BRANCH

The Branch is divided into three units, Policy Development, Policy Coordination, and Economic Information, and plays a central role in the overall functioning of the Ministry. Its main responsibilities lie in the development, coordination, and analysis of policy initiatives that affect the agriculture and food industry.

At the request of the Minister and senior Ministry officials, advisors and researchers in the Branch assess the economic implications of different policy choices. A number of projects are continuous including monthly newsletters on the latest data and developments in agricultural trade, in processing, distributing, and retailing (PDR), and in the farm supply business.

Economists in the Branch monitor foreign agricultural policies and developments in Ontario, other parts of Canada, and around the world and analyze them for their effects on the Provincial industry. Analyses have also been carried out on matters such as the development of food quality and safety standards, various GATT Panel rulings, the beef industry task force, income stabilization, and the grape and wine industry.

The Policy Coordination unit guides the flow of legislation, regulations, and orders-in-council between the Ministry and central agencies with which the Ministry is in constant contact. It also schedules meetings and conferences for senior officials.

The Economic Information Services unit monitors the efficiency of agricultural production through a number of avenues: surveys of farms and farm supply companies, computer models on costs of production, and collation of local with international data to yield commodity price and profitability forecasts for major commodities. The unit publishes Provincial agricultural statistics each year, and makes current domestic and international prices and commodity analysis for the main products available through the Farm Market News Service. This Service telephones information into radio stations for broadcasting and directly to anyone who wishes it.

PROJECT TITLE	RESEARCHER
Grain and forage crops, estimated production costs, Ontario, 1987	Fisher
An Ontario tomato production update, 1987	Fisher
Vegetable crops, estimated production costs, Ontario, 1987	Fisher
Fruit crops, estimated production costs, Ontario, 1987	McKibbon
Apple, peach, and grape estimated establishment costs Ontario, 1987	McKibbon
Maple syrup production in Ontario: costs, returns, and management practices, 1988	Buth

PROJECT TITLE	RESEARCHER
Cash rental rates in Ontario, 1987	Fisher
Food packaging study, 1987	Tmej
A survey of custom farm-work rates charged in Ontario, 1987	Fisher
Canada-USA trade negotiations: implications for the Canadian wheat-using industries	EPCB
Assessment of the proposed tariff snapback provisions for fresh fruit and vegetables	EPCB
Assessment of the impact of the Canada-USA Free Trade Agreement on the Ontario agriculture and food sector	EPCB

HORTICULTURAL RESEARCH INSTITUTE OF ONTARIO

HRIO is situated in the midst of Ontario's, and indeed Canada's prime horticultural region. It is made up of four units: the Horticultural Experiment Station and Horticultural Products Laboratory at headquarters in Vineland station, the Horticultural Experiment Station at Simcoe close to Lake Erie, and the Muck Research Station at Bradford in the Holland Marsh north of Toronto. Each unit has a specialized function, but the overall objective of the programmes is to develop crops and varieties which will help make Ontario more self-sufficient in these types of food, storage and processing technologies which will extend the market life of domestically grown produce, and mechanized crop management and energy conservation for efficient production.

At HES, Vineland, attention is focused on protected food crops, tender and small fruits, tree fruits, edible fungi, ornamentals and cut flowers, and plant nutrition for a variety of species. Including a grape sub-station, the land base is 90 hectares.

Researchers at the HPL, Vineland, investigate storage, handling, processing, and quality of harvested fruits and vegetables. The evaluation of cultivars from HRIO's breeding programme and of those from other regions is a very important part of their work. The Laboratory is increasingly concerned as well with the development of further-processed, added-value products.

The grape and wine programme as HPL is a long-standing one which includes specialists in bio-chemistry, engineering, food science, oenology, post-harvest physiology, sensory science, and microbiology. The recent development of sparkling and still grape juice products is helping make use of grapes of cultivars no longer used in winemaking.

HES, Simcoe, concentrates its efforts one-third on fruit and two-thirds on vegetables, a reflection of the commercial production in that area. Fruit research includes extensive work on apples as well as on small fruits such as strawberries, highbush blueberries, raspberries, currants, and the recently introduced tayberry from Scotland. Vegetable research emphasizes the mechanical harvesting of processing crops, particularly tomatoes and cucumbers, field tomato breeding, and the epidemiology and control of diseases.

In the past few years as well, an extensive programme to develop horticultural crops as alternatives to tobacco has been set up at Simcoe under the name of The Transition Crop Team.

At the three-hectare Muck Research Station, research is focused on crops grown in the organic soils of the ancient lake bottom: chiefly onions, carrots, lettuce, and celery. Cooperative studies are carried out with HPL on storage of these vegetables, and with the University of Guelph and Agriculture Canada on controls for various pests and diseases.

PROJECT TITLE	RESEARCHER
FOOD AND FOOD QUALITY	
Development of an ethylene measurement technique to determine apple harvest maturity.	Chu
Development of a starch-iodine test guide for maturity evaluation of Ontario apples.	Chu
Rootstock effects on harvest maturity of apples.	Chu
Controlled atmosphere storage of apples.	Chu
Low oxygen storage of apples.	Chu
Low ethylene storage of apples.	Chu
Studies on Paclobutrazol effects on apple maturity and storage life.	Chu
Studies on controlled atmosphere storage of green bell peppers.	Chu
Studies on cauliflower controlled atmosphere storage.	Chu
Evaluation of new grape varieties for wine production.	Edinger
Development of improved wine quality control methods.	Edinger
Modification of white wine production.	Edinger
Use of enzymes in wine production and analyses.	Edinger
Occurrence and control of microbial metabolites in wine.	Edinger
Recovery of useful constituents from grape pomace and other fruit and vegetable processing plant waste material.	Fuleki
Juice potential of commercial grape cultivars.	Fuleki
Analysis of chemical and physical indexes of quality of juice, wine, and table grape cultivars and selections.	Fuleki
Ultrafiltration and reverse osmosis in beverage technology.	Fuleki
Colour quality problems in horticultural crops and their products.	Fuleki
Anthocyanin pigment composition of horticultural crops grown in Ontario.	Fuleki
Chemical fingerprinting of fruits.	Fuleki
Development of HPLC - based analytical methods for quality control in the food and beverage industry.	Fuleki
Development of methods for measuring external and internal colour of fruits, vegetables and their products.	Fuleki
Storage facility operation and management.	Lauro
Development of storage monitoring technology.	Lauro
Energy aspects of storage.	Lauro
Technical and economic evaluation of fruit and vegetable storage systems.	Lauro
Automated environment monitoring.	Lauro
Engineering aspects of food processing.	Lauro
Storage studies on stone fruit.	Smith
Storage studies on peaches for processing	Smith
Strawberries - modified atmosphere (MA) packaging.	Smith
Storage studies on strawberries for processing.	Smith
Celery storage - development of technology for MA storage of Ontario-grown celery.	Smith
Improvement of cranberry growing in Ontario.	Smith
Crucifer crop storage studies.	Smith
Onion storage studies.	Smith
Post-harvest physiology and storage trials	Valk
Processing quality studies on tomatoes.	Wang
Quality monitoring techniques for processing tomatoes.	Wang
Processing studies on stored peaches.	Wang

PROJECT TITLE	RESEARCHER
Processing quality studies on peaches.	Wang
Processing quality studies on small fruit.	Wang
Processing studies on strawberries.	Wang
Processing quality studies on apricots.	Wang
Processing quality studies on bell peppers.	Wang
Utilization of surplus and waste fruit and vegetable materials.	Wang
Application of improved freezing methods on fruit and vegetables.	Wang
Processing of honey products.	Wang
Microbiological stability of horticultural food and beverage products.	Chudyk
Geographic analysis of grape quality in Ontario.	Chudyk
Microbiology of storages.	Chudyk

HORTICULTURAL CROPS

Fruit

PROJECT TITLE	RESEARCHER
Breeding for wine grapes adapted to Ontario conditions	Fisher
Grapevine population studies in relation to yield and quality	Fisher
Training systems for grape cultivars	Fisher
Grape rootstocks - scion/rootstock combinations, for non-vinifera cultivars	Fisher
Soil management irrigation and summer pruning interaction on Riesling/3309 grapevines	Fisher, Cline
Summer pruning of vigorous grape cultivars	Fisher
Grape breeding for dessert cultivars adapted to Ontario climatic conditions	Fisher
Apricot breeding and cultivar evaluation	Fisher, Wang
Grape rootstocks for vinifera cultivars	Fisher
Vinifera cultivar and training combination trial	Fisher
Cold hardiness surveys with grapevines	Fisher
Growth regulators in the vineyard	Fisher
Peach cultivar evaluation for canker resistance	Miles, Biggs
Breeding field resistance of peaches to canker disease	Miles, Biggs

PROJECT TITLE	RESEARCHER
Breeding clingstone peaches	Miles, Biggs
Peach and nectarine cultivar evaluation	Miles, Wang
Propagation methods for peach trees	Miles, Chong
Trellised peach orchard studies	Miles, Cline
Evaluation of prunus rootstocks for peach	Miles
Protected fruit culture - peaches	Miles, Cline
Protected fruit culture - apples	Miles, Elfving
Protected fruit culture - kiwifruit	Miles
A rapid technique for obtaining cytospora resistant peach plants	Chong, Miles, Biggs
Breeding sour cherry cultivars superior to Montmorency	Tehrani
Breeding for early maturing European and Japanese plums and pollen compatibility studies with plums	Tehrani
Breeding for a seasonal succession of firm-fleshed non-cracking, self-fruitful black sweet cherry cultivars and determination of incompatibility group of selection	Tehrani
Management studies with Bartlett pear on Quince rootstock	Tehrani
Regional pear rootstock and cultivar trials	Tehrani
Growth and productivity of Japanese plum cultivars on different rootstocks	Tehrani
Influence of different selections of *Prunus mahaleb* rootstock on productivity and growth of two tart cherry cultivars	Tehrani
Response of European plums to replant ridging on a Jeddo clay loam soil	Tehrani
Performance of Anjou, Bartlett, and Bosc pear on standard and Old Home X Farmingdale clonal rootstock	Tehrani
Spacing trial with Bartlett pear on standard rootstock	Tehrani
Regional European plum cultivar and rootstock planting	Tehrani
Influence of rootstock on productivity and growth of European plum cultivars and early blue Vineland selections	Tehrani
Influence of rootstock on performance of advanced self-fruitful selections and standard sweet cherry cultivars	Tehrani
Influence of Colt, Mahaleb, and Mazzard rootstocks on the performance of Montmorency and Meteor tart cherries	Tehrani

PROJECT TITLE	RESEARCHER
Influence of Colt, MXM14, P.Mahaleb and P. Mazzard rootstocks on productivity and growth of sweet and tart cherry cultivars	Tehrani
NC-140 cooperative sweet and tart cherry rootstock trials	Tehrani
Evaluation of eight size-controlling Quince rootstocks with compatible Bartlett	Tehrani
Rootstock and training study with Anjou, Bartlett and Flemish Beauty pear cultivars on three Quince rootstocks	Tehrani
Effects of plant growth regulators on apple	Elfving
Orchard factors influencing apple fruit quality	Elfving
Apple rootstock evaluation	Elfving
Apple cultivar evaluation	Elfving
Development of improved strawberry cultivars for fresh market and processing	Dale
Coordinated small fruit trials in Ontario	Dale
Management of small fruit crops	Dale
Evaluation of wild *Fragaria Virginiana* clones for useful characteristics in ev. breeding	Dale

Vegetables and Edible Fungi

Greenhouse tomato crop management	Straver, Ingratta
Greenhouse sweet pepper management	Straver, Ingratta
Greenhouse vegetable production on substrates	Straver, Ingratta
Seedless greenhouse cucumber production	Straver, Ingratta
Mushroom compost - substrate preparation and formulation	Rinker
Production of alternate fungi	Rinker, Patrick
Mushroom crop management - response to supplementation	Rinker
Mushroom crop management - casing soil studies	Rinker
Potato management and physiology	McKeown
Tomato management and physiology	McKeown
Seed potato management and physiology	McKeown
Production practices for vine crops	O'Sullivan
Influence of cultivars and other factors of production on yield and quality of peppers	O'Sullivan
Alternative crops for tobacco farms	Schumacher
Cole crop production and management	Schumacher
Asparagus production and management	Schumacher
Garlic production	Schumacher
Field tomato breeding	Brammall
Greenhouse tomato breeding	Brammall
Tomato genetics	Brammall
Cultivar evaluation trials	Valk

Ornamentals

Development of Alstroemeria as a greenhouse crop	Blom
Commercial parameters for production of Anemones in greenhouses	Blom
Influence of soil cooling on greenhouse Freesia production	Blom
Factors influencing greenhouse Gerbera production	Blom
Factors influencing greenhouse Poinsettia production	Blom
Greenhouse roses on rockwool	Blom
Evaluation of rooting media for Poinsettia cuttings	Blom
Evaluation of Easter Lily production techniques	Blom
Comparison of double acrylic and single glass for greenhouse glazing	Blom
Evaluation of polyetheylene films for greenhouse glazing	Blom
Evaluation of *P. vulgaris* and *P. polyanthus* cultivars and timing of *P. vulgaris* by photoperiodic control	Blom
Micropropagation of ornamentals	Chong
Effect of aerial and rooting environment on rooting of woody ornamental nursery crops	Chong
Rooting media for propagation of ornamental cuttings	Chong
Influence of growth substances on rooting of woody ornamentals	Chong
Field-grow fabric container culture	Chong, Cline
Soil amendments for containerized nursery crops	Chong, Cline, Rinker
Rhododendron evaluation	Chong
Chemical protectants for roadside salt spray	Chong
Caliper ornamental nursery tree production using field-grow containers and trickle irrigation	Chong, Lumis

PROJECT TITLE	RESEARCHER
PEST MANAGEMENT AND DISEASE CONTROL	
Mushroom pest management - evaluation of pesticides	Rinker
Development of herbicide programs for various horticultural crops	O'Sullivan
Vegetable pathology	Brammall
Herbicide trials	Valk
Crop protection trials	Valk

PROJECT TITLE	RESEARCHER
SOIL, WATER, AND WASTE MANAGEMENT	
Nitrogen fertilization of greenhouse roses	Blom
Evaluation of different irrigation systems for containerized production	Blom
Influence of pH on rooting of ornamental cuttings	Chong, Blom
Effects of nitrogen fertilization on dwarf apple trees	Elfving
Irrigation of size-controlled apple trees	Elfving
Soil management trials	Valk
Crop management fertility trials	Valk
Environment quality projects	Valk

KEMPTVILLE COLLEGE OF AGRICULTURAL TECHNOLOGY

Eastern Ontario has been an area which specialized in livestock and forage crops. In recent years, however, farmers have expanded their repertoire to include crops such as soybeans and blueberries. This diversification has been stimulated to a great extent by research at Kemptville which has selected cultivars tailor-made for the region and has developed production methods to fit.

The region has about 30% of the Province's dairy cattle and sells about $250 million worth of milk a year. Dairy research at the College supports this efficiency with widely based studies on calf nutrition and health, improving the growth of replacement heifers, and diets for lactating cows. The heavy calf project is part of this programme.

Beef cattle research is aimed chiefly at lowering production costs. In field crops, KCAT's agronomists help provide the research committees with variety and management data from trials on corn, soybeans, cereals, and forages and with regional recommendations on soil management and weed control.

In horticulture, research has helped develop the industry in the area. Local strawberry production has become quite a successful business and the growing of lowbush blueberry bushes for commercial purposes has the potential to be. KCAT has the only maple syrup bush in which research is carried out on improved syrup quality and energy efficiency in production.

The Food Services section of the College supports other research through quality assessment.

PROJECT TITLE	RESEARCHER
LIVESTOCK	
Increasing the energy and protein density of high moisture ear corn diet with bypass protein and fat	Drevjany
Attempt to formulate a calf starter which will encourage early intake - Phase III	Drevjany
Starter consumption in newborn Holstein bull calves	Drevjany
Effect of splitting the first milking of fresh cows into two fractions on the content of immunoglobulins in each fraction	Drevjany
Influence of Megalac on milk production by high producing cows in early lactation - effects of Megalac on grain palatability and production costs	Wheeler
Effect of various methods of encouragement on early intake of calf starter	Drevjany
Effect of hay availability on calf starter intake by newborn calves	Wheeler

PROJECT TITLE	RESEARCHER
ECONOMICS	
Computerizing the Blue Book	Morrison
Comparison of Eastern Ontario and New York State dairy enterprises	Morrison
Canada Pension Plan Factsheet for farmers	Pickard
Survey on employment of two previous years' graduates	Pickard
Survey of graduates of five and ten years ago on value of program courses	Pickard
Assessment of agricultural diploma courses by surveying first and second year students	Pickard
ENGINEERING	
Determination of the occurrence profile of manure gas	Clarke
Detailed monitoring of dairy barns indicating manure gas problems	Clarke
Mole drainage and crop management	Cuthbertson

PROJECT TITLE	RESEARCHER
ENGINEERING (continued)	
Hay drying fan evaluation	Gillespie
Field evaluation of natural air corn drying in Eastern Ontario	Plue
Big bale hay drying	Plue
On-farm evaluation of the performance and reliability of new fan and heater controls	Plue
Evaluation and adaptation of drainage cost/benefit software	Toombs
Development of a trial expert system for silos	Toombs
FIELD CROPS	
Grain	
Cereal fertility project	Curnoe
Cereal variety project	Hoekstra
Cereal management project	Hoekstra
Cereal herbicide project	MacDonald
Corn fertility project	Curnoe
Corn variety project	Hoekstra
Corn herbicide project	MacDonald
Forage	
Forage fertility project	Curnoe
Forage herbicide project	MacDonald
Forage management project	Madill
Forage variety project	Madill
Protein & Oilseed	
Oilseed herbicide project	MacDonald
Oilseed management project	Madill
Oilseed variety project	Madill

PROJECT TITLE	RESEARCHER
HORTICULTURAL CROPS	
Fruit	
Blueberry cultural practices	Morton
Small fruit variety trials	Morton
Tree fruit variety rootstock trials	Morton
Vegetables	
Vegetable variety trials for Eastern Ontario a) Potatoes, early and late b) Sweet corn c) Asparagus	Langenberg
Vegetable management trial for Eastern Ontario a) Sweet corn b) Potato	Langenberg
Maple Syrup	
Maple syrup production a) Energy conservation b) Quality control	Langenberg
FOOD AND FOOD QUALITY	
Sensory and texture evaluation of small fruit crops (strawberries, blueberries, raspberries) – Part A	Reasbeck, Johnson
– Part B	Reasbeck
Sensory and texture evaluation for vegetable crops (potatoes, asparagus and corn) – Part A	Johnson, Reasbeck
– Part B	Sanderson, Reasbeck
Recipe development - maple products	Sanderson, Johnson
Influence of storage conditions on apple quality	Johnson
Evaluating the chemical, textural and sensory properties of red veal, white veal and beef	Johnson
Thermal precipitation of proteins from milk whey blends	Hunter

NEW LISKEARD COLLEGE OF AGRICULTURAL TECHNOLOGY

New Liskeard, the Ministry's most northerly college, has developed a comprehensive research programme to assist farmers in this particular area. This year, crop testing sites are under development in the districts of Rainy River and Thunder Bay to give farmers in the Northwest of the Province recommendations suitable to their conditions. An Agronomy Research Laboratory is under construction as well on the New Liskeard campus, facilities which will enhance the research programme there.

Research is carried out here in beef cattle, field and horticultural crops, and farm management. The cow-calf herd was expanded recently to allow for a more wide-ranging programme on nutrition, breeding efficiency, and feeding animals on pasture. This reflects the importance of this industry in Northern Ontario. Along with agronomic research, chiefly in barley, oats, and forages, horticultural studies in berries, sweet corn, and cole crops are helping farmers diversify.

PROJECT TITLE	RESEARCHER
LIVESTOCK	
Beef	
Pasture development in Northern Ontario	Callaghan
Dairy	
Stray voltage effects on dairy cattle	Gumprich
Sheep	
Pasture test for rams	Sharpe
Kale and rape as late autumn pasture for ewes	Sharpe
ENGINEERING	
Soil stabilization in heavy traffic areas	Hawkins
Stray voltage survey	Hawkins
Field sprayer marking device	Hawkins
Low temperature grain drying	Hawkins
Self-adjusting ridge ventilator	Hawkins
FIELD CROPS	
Grain	
Intensive barley production	Skepasts
Barley variety testing	Skepasts
Oats variety testing	Skepasts
Wheat variety testing	Skepasts
Miscellaneous grains variety testing	Skepasts
Effect of date of seeding and rate of nitrogen in oats	Skepasts
Response of barley and alfalfa to limestone in Northern Ontario	Skepasts

PROJECT TITLE	RESEARCHER
Forage	
Alfalfa seed production in Northern Ontario	Skepasts
Forage grass cultivar evaluation	Skepasts
Forage legume cultivar evaluation	Skepasts
Silage corn hybrid evaluation	Skepasts
Gene pool corn test	Skepasts
Simulated pasture management test	Skepasts
Protein and Oilseed	
Canola variety testing	Skepasts
Flax variety testing	Skepasts
Soybean variety testing	Skepasts
Field peas variety testing	Skepasts
Nitrogen fertilization of canola in Northeastern Ontario	Rowsell
HORTICULTURAL CROPS	
Effects of plastic mulch, support systems, and direct seeding vs transplanting	Hughes
Biennial cropping of raspberries	Hughes
Raspberry cultivar evaluation	Hughes
Strawberry cultivar evaluation	Hughes
Flat row vs raised beds for strawberry production in Northern Ontario	Hughes
Chinese cabbage - preliminary trial	Hughes

RIDGETOWN COLLEGE OF AGRICULTURAL TECHNOLOGY

About one-third of our agricultural production comes from Southwestern Ontario. It has the highest heat unit range in Canada, a favourable climate, and a broad selection of fertile soils. Research to assist this bountiful harvest has been going on at Ridgetown for 65 years, since its founding in 1922 as the Western Ontario Experimental Farm.

The swine programme is the main focus of livestock research, but work is also carried out with beef and dairy cattle. The purebred Holstein herd is consistently the highest producing herd in Kent County.

Since 60% of the region's farmland is in field crops, chiefly soybeans, corn, and winter wheat, extensive testing and monitoring is done on varieties and corn hybrids in these crops. In horticultural crops as well, emphasis is placed on cultivar testing and management systems for efficient production. Pest management studies complement these studies.

Agricultural engineering research reflects this 'crop' mix with work on both livestock housing and tillage machinery and storage facilities. Soil researchers carry out work as well on tillage methods along with studies on windbreaks and shelterbelts, interseeding to halt soil degradation, and fertilizer application trials.

In the farm management area, Ridgetown's economists develop and refine financial and record-keeping methods easily adapted to individual farms, and analyze production systems and marketing strategies. The use of the computer in farming is an important part of this programme.

PROJECT TITLE	RESEARCHER
LIVESTOCK	
Beef	
The effect of frame size and post-partum energy intake on reproductive performance in beef cows	Osborne, DeSchutter
Alfalfa silage in feeder steer diets	Osborne
Computer software development, livestock enterprise models for profit and sundry software development analysis	Morris, Osborne DeSchutter
The effect of preconditioning on the performance of beef calves	DeSchutter
Dairy	
Application of chronobiological techniques to parturition in dairy and beef cattle	Osborne
Multiple concentrate feeding to dairy cattle	Osborne
Swine	
Two-tiered rearing for growing pigs	Morris, Underwood
Controlled feeding for pigs	Morris
Causes of preweaning piglet mortality	DeSchutter
The economical and nutritional implications of feeding mouldy corn to swine	DeSchutter
Roasted soybeans for growing pigs	Morris
Naked oats for growing pigs	Morris
Lysine supplementation for growing and/or finishing pigs	DeSchutter
Effectiveness and profitability of creep feed programs for young pigs	DeSchutter
The efficacy of PGH on growth performance and carcass merit of market pigs	Morris
ECONOMICS	
Gross margin analyses of corn weed control data	Beattie
Computer accounting and enterprise analyses development	Beattie
Potential for computer use on the farm	Ross
Analysis of Ontario cash corn prices cycles	Doidge
Analysis of farm production systems	Beattie
Farm machinery capital budgeting	Ross
Agricultural options usage versus alternative marketing methods	Doidge
Analysis of Ontario elevator buying/ selling price spreads	Doidge

PROJECT TITLE	RESEARCHER
Cost/benefit analysis of weed control in soybeans using inter-row seeding and other techniques	Beattie
ENGINEERING	
Ventilation control in swine barns	Underwood
Spray cooling in naturally ventilated barns	Underwood
Low temperature grain drying	Underwood
FIELD CROPS	
Grain	
Hybrid corn evaluation for grain and forage	McLaren
Tissue analysis for nutrient content as affected by various fertilizer practices	Johnston, Brimner
Tissue analysis for nutrient content as affected by various fertilizer practices (nitrogen and phosphorus)	Johnston, Brimner
Micronutrients in field crops - yield and nutrient composition practices - zinc, manganese, copper, boron	Johnston
Evaluation of potential of broomcorn in Southwestern Ontario	McLaren
Cereal management	Smid
Production studies in grain corn	McLaren
Evaluation of cereal cultivars	Smid
Forage	
Forage varieties and management	McLaren
Proteins and Oilseeds	
Cultural studies in soybeans	Ablett
Evaluation of field bean types and cultivars	Ablett
Cultural studies in field beans	Ablett
Development and evaluation of soybean cultivars	Ablett
Chickpea production in Southwestern Ontario	Ablett
Alterations of fatty acids in soybeans	Ablett
Winter canola production	Ablett
HORTICULTURAL CROPS	
Fruit	
Performance and hardiness testing of tender fruit, grapes and apple varieties in Kent County	Muehmer

PROJECT TITLE	RESEARCHER
Vegetables	
Cultivar testing and management studies of various vegetable crops in greenhouses	Muehmer
Breeding, cultivar testing and management studies with processing peppers	Muehmer
Cultivar testing and management studies with cole crops and other small acreage crops	Muehmer
Cultural and management studies in processing tomatoes under Southwestern Ontario conditions	Muehmer
Cultivar testing and evaluation of processing and greenhouse tomatoes	Muehmer
Production research in processing vegetables	Schaafsma
Cultural and management studies of vegetable transplants in high density trays under Southwestern Ontario greenhouse conditions	Muehmer
PEST MANAGEMENT AND DISEASE CONTROL	
Effect of herbicides on weed control and field corn	Brown
Effect of herbicides on weed control and crop response in vegetable and fruit crops, transplanted and field seeded tomatoes, peppers, asparagus and fruit trees	Brown
Studies in the control of specific weeds	Brown
Soil insect control in field corn	Schaafsma
Insect and disease control in field tomatoes	Pitblado
Herbicides in the control of specific weeds	Shaw
Disease control in horticultural crops	Pitblado

PROJECT TITLE	RESEARCHER
Insect control in horticultural crops	Pitblado
Disease control in field crops	Schaafsma
Foliar insect control in field crops	Schaafsma
Weed control in vegetable crops	Shaw
Weed control in beans	Shaw
Weed control in cereals and forages	Shaw
Weed management systems in reduced-till field crops	Shaw
SOIL WATER AND WASTE MANAGEMENT	
Energy conservation in tillage and residue management for crop production in Southwestern Ontario	Young
Nitrogen research with winter wheat	Stevenson
Nitrogen research with corn using conservation tillage	Stevenson
Shelterbelt protection and crop growth and yield	Baldwin
Interseeding in corn	Baldwin, Nanni
Phosphorus and potassium soil test calibration research with soybeans	Stevenson
Phosphorus and potassium soil test calibration research with corn	Stevenson
Crop production with no traffic tillage system	Baldwin
Nitrogen on hard red spring wheat	Baldwin
Effect of hybrid plant population and plant nutrients on growth and yield of corn	Stevenson
Composted sewage sludge on corn and soybeans	Baldwin

UNIVERSITY OF GUELPH

For over a century, the Ontario Agricultural College, the Ontario Veterinary College, and since the 1960,s, other Colleges at the University have run research programmes on behalf of the Ministry. The nature of these programmes has changed a great deal over the years, and the scope has broadened dramatically. New disciplines such as environmental biology, plant and animal biotechnology, and energy management have been introduced to complement traditional ones such as animal husbandry and horticulture.

In the early years, research and demonstrations were held on what is now the University campus. Now, much of this work has been moved to the seven experimental farms owned by the Ministry and run, under contract, by the University: Alma (aquaculture), Arkell (swine, poultry, engineering, environmental biology), Cambridge (horticultural crops, turf management, pest management), Elora (beef, dairy, field crops, soils), Guelph (feed production), Ponsonby (animal health), and Woodstock (field crops). The main areas emphasized in each of Guelph's agricultural research programmes are listed below followed by the titles of current projects within each programme.

PROJECT TITLE	RESEARCHER
LIVESTOCK	
Beef	
Improving beef cattle testing programs	Wilton, Schaeffer
Characteristics of donors and recipients influencing the efficiency of beef production through embryo transfer	Wilton
Determination of genetic differences in feed conversion rates for beef cows and feedlot cattle	Wilton, Wilson
Factors affecting fertility of beef cows	Mowat
Solid-state 13c (CP-MAS) NMR spectroscopy of forages	McBride
Relationship between protein synthesis and NA+/K+ transport in ruminant tissues	McBride
Microscopic and endocrinological investigation of maternal/conceptus interactions during gestation	King
Separation and utilization of whole plant corn silage	Mowat
Feeding frequency on the utilization of high-roughage diets	Mowat
Alfalfa silage for growing weaned calves	Buchanan-Smith, Mowat
Regulation of protein metabolism to control body composition in cattle	Ball, McBride, Early
Warm carcass grading and quality evaluation of beef carcasses	Usborne, Gullett, Reist
Bovine collagen metabolism	Ball, Bruce, Crogie
Productivity of beef cattle on pasture	Clark, Buchanan-Smith, McDonald
Inter-relationships between nutrition and the manifestation of lung disease in ruminants	Bray, Acton, Wong
Characterization of the fibrolytic enzymes from bacteroides succinogenes	Forsberg McGavin, Huang
Development potential of bovine oocytes matured and fertilized in vitro	Walton, Basrur, Stubbings
Dairy	
Nutritive value of alfalfa silage	Buchanan-Smith
Development of an automated system of measuring milking speed in dairy cows	Burnside, Schaeffer, Sullivan
Evaluation of Holstein-Friesian A.I. sires for stillbirths and ease of calving	Burnside, Schaeffer, Freeman
The relationship between the motor activity and production of dairy cows	Hurnik, Amyot
The effects of plant and fish protein in pre-ruminant calf diets on growth, health and immunological parameters	Burton, Srihara
Genetic and environmental causes of immunoglobulin levels in Canadian dairy cattle	Burton, Burnside, Wilkie, Mallard, Robertson, Srihara

PROJECT TITLE	RESEARCHER
Effect of ration protein degradability on lactation response	Grieve, Buchanan-Smith, MacLeod, Ganesh, Barney, Kreager
Comparison of Canadian Holstein and New Zealand Friesian A.I. sires	Burnside, Burton, McBride, Haluke
Efficacy of Recombinant Growth Hormone (RBGH) for lactating cows.	Burton, MacLeod, Bateman, Colucci, McBride, McMillan
Evaluation of Holstein-Friesian A.I. sires for stillbirths and ease of calving	Burnside, Schaeffer, Freeman MacLeod, Ganesh, Barney, Kreager
Consequences of fibre upon digestive function and productivity of lactating cows	Buchanan-Smith MacLeod, Allen Grovum, Zelin, Beauchemin
The sensitivity and specificity of cowside milk progesterone tests	Leslie, Walton, Etherington
Feeding strategies to enhance rumen function and productivity of dairy cows	Grieve, Buchanan-Smith Macleod, Moore
Growth rates, composition and performance of dairy replacement heifers	Grieve, Buchanan-Smith, McBride, Stelwegon, Niezen
Influence of prepartum feeding & body condition on feed intake milk production & health in early lactation	Grieve, MacLeod, Burton, Moore
Methods for genetic improvement of dairy cattle	Kennedy
Sire and cow evaluation methods	Schaeffer, Kennedy
Effect of nutrition on reproduction of dairy bulls entered into A.I. units	Grieve, Buchanan-Smith, King, Meadows
Genetic manipulation of bacteroides succinogenes to enhance fibre digestion in the rumen	Gibbins, Muysson, Lawrence
Construction of diagnostic probes for virulent ureaplasma spp. in cattle	Gibbins, Campbell
Antibodies as hormones: the use of anti-idiotypic antibodies to enhance animal performance	Walton, Ramkumar, Schalla, Kreager, Barney
Swine	
Ingestive behaviour of neonatal piglets	Hurnik, Morrison, Fiola
Triticale in diets of pigs	Young
Nutrition and management of pigs for reproduction	Young, King, Walton
The effect of leanness on the quality and processing attributes of pork	Jones, Kennedy, Gullett

PROJECT TITLE	RESEARCHER
Initiation of pregnancy in pigs	King
Porcine embryo culture	Johnson, King, Yamashiro
Determination of factors affecting effective environmental temperature for the young pig	Morrison, Braithwaite
Effect of dietary amino acids on polyamine metabolism in swine	Smith
Treatment of T-2 toxicoses by supplemental dietary amino acids	Smith
Proline metabolism in young pigs	Ball
Assessment of management factors determining excretory behaviour of growing-finishing pigs	Morrison, Hacker, Ogilvie
Zearalenone in diets of reproducing swine	Young, King
Protein and available amino acid requirements of pigs	Young, Adiola
Histological observations of the small intestine and performance of starter pigs fed different protein sources	Young, Barker, Wilkie, Klesouik
Genetic improvement of swine on a population basis	Kennedy
Effect of board odors on ovarian function in gilts and sows	Walton, Ball
Influence of electronic feeding on sow reproduction	Hacker, Evans, Evans
Fat utilization in swine	Young, Darko
Effect of amino acid supplementation on stress, meat quality and body composition in swine	Ball

Poultry

PROJECT TITLE	RESEARCHER
Efficacy of growth promotors, antibiotics and anticoccidials for poultry	Leeson, Bell, Mast
Nutrient requirements of growing pullets and laying hens	Summers, Porr
Protein evaluation	Summers
The control of ovulation in domestic birds	Etches
Poultry egg production curves	McMillan
Behaviour of hens in battery cages	Hurnik
Development of feeding systems for poultry	Lesson, Hurnik, Bell, Mullen, Snyder
Environmental factors affecting efficiency of production in poultry	Morrison
The control of egg-yolk protein synthesis in domestic birds	Gibbins, Forsberg, Copeland, Brazalot
Salt reduction in processed poultry products	Barbut
Development of methods of gene transfer in domestic birds	Etches, Petitte, Anderson-Langmuir, Clark
Isolation, identification and characterization of reproductive hormones in domestic birds	Etches, Petitte, MacDonald-Jones, Soneda, Anderson-Langmuir
Lighting regimes for turkey toms	Etches
Factors regulating the development of a single functional ovary in poultry	Squires, Nixon, Bell, Hurnik
Investigation of the molecular basis for fatty liver hemorrhagic syndrome	Squires, Nixon, Bell, Hurnik

Fish

PROJECT TITLE	RESEARCHER
Alternative protein sources in practical diets for rainbow trout	Hilton
Gill disease of fish	Ferguson
Development of new processing methods of practical diets for Rainbow Trout	Hilton
Significance of neoplasia in wild fish populations	Hayes, Ferguson,
Evaluation of Tiger Trout hybrids for aquaculture	McMillan, McKay
The biotin requirement of young Rainbow Trout	Woodward
Effect of tank colour and astaxanthin level on the growth and pigmentation of trout	Hilton
Availability and stability of different forms of ascorbic acid in trout diets	Hilton
Disease in British Columbian fish hatcheries and cage sites, with particular reference to Pacific salmon	Ferguson, Armstrong
Evaluation of the effects of administration of hormones on growth rate, blood and tissue comp. of Rainbow Trout	Leatherland, Farbridge, Lin
Development of a growth hormone assay for Rainbow Trout	Leatherland, Etches, Farbridge, Lin
Proteogenic effect of dietary leucine in skeletal muscle of Rainbow Trout	Smith, Choo, Cho
Fish waste production - Rainbow Trout culture	Chisholm, Farrell, Masanic
Fish species susceptibility to yersinia ruckeri	Stevenson, Flett
Gene probe for infectious pancreatic necrosis virus of fish	Stevenson, Dobos, Lee
Gene probe for bacterial kidney disease of fish	Stevenson, Daly Duncan
Gene probe for enteric redmouth disease of fish	Stevenson, Duncan

PROJECT TITLE	RESEARCHER
Bees	
Pollination and seed quality and harvest in oil seed crops	Kevan
Requirements for pollination in small fruits	Kevan
Biology and control of parasitic mites of honey bees	Otis, Scott, Dawicke, Watkins
Honey bee biology and management	Otis, Huang
Introduction of insecticide resistance genes into beneficial insect species	Phillips, Milne, Krell
Biomedical Sciences	
3-methylindole induced pulmonary edema and metabolic basis of prolonged pulmonary disease in ruminants	Atwal, Jassal, Minhas
An investigation into the nature prevalence and significance of congenital Factor XI Deficiency in cattle	Gentry, Ross, Dejong
Metabolic and morphologic basis of pulmonary alveolar-capillary permeability and detoxification of metabolites	Atwal, Minhas, Jassal
Stereoid biosynthesis in the testes of the boar	Raeside, Renaud, Ryan
Measurement of estrone sulphate in milk as a method for early confirmation of pregnancy in cows	Raeside, Friendship, Leslie, Sandals
Brown adipose tissue: a physiological and biochemical study	Harris, Yamashiro, Robinson
Pathogenesis of mycotoxicosis in domestic animals.	Gentry
Reproductive problems in twin bulls produced by embryo transfer	Basrur
Direct action of glucocorticosteroids on the ovary in the pig	Raeside
Analysis of the intersex syndrome(s) in swine	Fisher, Partlow
Structural difference of airways in domestic animals and their significance in respiratory diseases	Yamashiro
Porcine embryo culture	Johnson, King, Yamashiro
Pharmacological study of the equine hoof in relation to the etiology and therapy of laminitis	Black
Endocrinology of gestation in the mare	Raeside, Savage
Study of lavage and biopsies for diagnosis of respiratory diseases	Yamashiro, Willoughby, Viel, Croy, Bast
Assessment of immunocompetent cells within the pregnant uterus	Croy
Combined toxicity of mercury, lead and cadmium in domestic ducks	Bhatnagar, Stewart-Liland, Jordan, McNeil

PROJECT TITLE	RESEARCHER
Correlative uterine and ovarian histology and plasma steroid levels in sows with experimentally induced cystic ovaries	Geissinger, McDonald-Taylor
Oxytocin challenge test in the cow	Liptrap
Actinides and estrogens as environmental contaminants in poultry	Robinson, Floto, Wasnidge
Acquired disorders of hemostasis in the horse: the role of natural inhibitors	Johnstone, Crane
Small intestine function in the calf	Chapman, Bignell
An evaluation of dosage level and treatment interval of levamisole in the prevention of shipping fever pneumonia	Black, Conlon, Burger, Claxton, Kuipers
T cell receptor genes in domestic animals	Croy, Yager, Kruth
Detection of antibiotic residues in milk following intrauterine infusions	Black, Claxton, Kuipers
Direct effects of glucocorticoids on porcine ovarian function	Liptrap, Cummings, Huether
Vascular stress in swine	Downie, Crosbie, Parker
The role of sensory receptors and endocrine factors in controlling rumen function and food intake in ruminants	Grovum, Bignell
Plasma fibronectin in domestic animals	Gentry
An epidemiological study of antibiotic residues in bulk milk from Ontario dairy farms	McEwen, Black, Meek, Elliott
Development of biotechnological methods of embryo manipulation for advancement of the embryo transfer industry	Betteridge, Wildeman, Johnson, Croy King, Scodras
Hair growth disorder in ranch foxes	Goldberg, Hardy-Fallding, Braham
The use of a GNRH antagonist to delay ovulation in superovulated Holstein heifers, and its effect on numbers, development and morphological quality of embryos	Rieger, Johnson, Walton, Beriault
Fertility in beef bulls	Johnson, Etherington, Buckrell, Bonnett, Liptrap, Wilton
Investigation into effects of toxins on disease resistance of animals	Boermans, Claxton
Pharmacokinetics and toxicity of second generation anticoagulants in the equine	Boermans, Black, Johnstone, Claxton
Relaxin and the timing of birth/relaxin and blood pressure in pregnancy	Summerlee

PROJECT TITLE	RESEARCHER
Effect of pasteurella haemolytica exotoxin on bovine alveolar macrophage function	Conlon, Burger
The pathogenesis of pasteurella haemolytica cytotoxin on bovine airway smooth muscle	Harris, Yamashiro
A study of the effects of levamisole on cellular responses to a respiratory virus in cattle	Conlon, Black, Burger, Karrow
The possible involvement of relaxin in porcine hypogalactia	Porter, Norman, McMurray, Wasnidge
Study of biology of pregnancy establishment in horses	Betteridge
Dermal-epidermal and other interactions in differentiation and disorders of mammalian skin	Fallding, Roff Austen
The embryonic genome and its expression during early development	King, Kang Pu Xu, Pollard

Pathology

PROJECT TITLE	RESEARCHER
Surveillance of parasite diseases of domesticated animals in Ontario	Slocombe
Host parasite interaction in the coccidia - pathogenetic	Fernando
Experimental oncology	Valli
Pathogencity of the H. Somnus complex in the bovine	Little
SDA; an important coronavirus infection in the rat	Percy
Surveillance of diseases in laboratory animals	Percy
Studies on lameness and leg problems in broiler chickens and turkeys	Julian
Immunopathogenesis of bovine ocular squamous cell carcinoma	Stirtzinger, Valli, Livesey
Strongyles in equines: biology, pathogeneses, epidemiology and control	Slocombe, McCraw
Control of pasteurellosis in the rabbit	Percy
Investigation to determine the cause of sudden death syndrome in broiler chickens	Julian, Hunter
Biochemical analysis of the serum of leghorn layer flocks: comparison of normal flocks and those with poor egg or shell quality	Julian, Lumsden
Effects of ureaplasma diversum on bovine embryos: in vitro studies	Miller, Fernando, Rosenberg, Foster, Ruhnke
Control of lungworm meullerius capillaris in dairy goats by strategic anthelmintic treatment and herd management	Menzies, McCraw
Association between physiologic status immune response and respiratory disease in feedlot cattle	Martin, Lumsden, Meek
Investigation into reproductive failure and normal mortality on mink ranches	Hunter
Natural bone disease in sheep as a model for osteogenesis imperfecta in man	Hulland
Right ventricular failure and ascites in broiler and roaster chickens	Julian
Immunopathogenesis of infection with bovine leukemia virus	Valli
Ureaplasma diversum as a cause of infertility in cattle	Miller
Investigation of Staphylococcus infection in neonatal mink	Hunter, Yager, Prescott
Pathogenesis and prevention of Rhodococcus equi pneumonia	Yager
Development of specific DNA probes for the rapid identification of Salmonella spp. in poultry products	Lo
Significance of Neoplasia in wild fish populations	Hayes, Ferguson
Investigation into respiratory disease in turkeys	Hunter
Effects of coliform verotoxin on neonatal calves	Valli
Restriction endonuclease analysis of bovine leukemia virus genetic variants	Jacobs
T cell receptor genes in domestic animals	Croy, Yager, Kruth
Enteritis complex in the commercial rabbit: a field study	Percy
Histopathological study of normal and dead avian embryos and membranes	Julian
Actinobacillus pleuropneumoniae: the evaluation of a major toxin in pathogenesis and its use in treatment and control	Little, Brash, Arnott
Prevention of downgrading losses in turkeys	McEwen, Julian, Barbut, Elliot
The relationship of various health factors to milk composition and culling in dairy cattle	Valli, Leslie, Godkin, Vernau, Szijavto, Vizi
Definitive diagnosis of susceptibility to porcine stress syndrome: development of a cost effective protocol for clinical application.	O'Brien, Kuipers
Effects of PCB (Aroclor 1254) on the cervical apocrine gland of neonatal mink	Hunter, Yager

PROJECT TITLE	RESEARCHER
Veterinary Microbiology and Immunology	
Improved diagnostic and prophylactic procedures for the control of Pleuropneumonia in Ontario swine	Rosendal, Watson, Devinish, Edwards, Xun, Ricciatti, Lian, Johnson
Host resistance to pasteurella haemolytica	Shewen, Wilkie
Genetic control of immune response and disease resistance in pigs	Wilkie, Mallard, Kendall, Saunders, Limebeer, Stickland, Remmler
Pathogenesis of the disease in goats caused by Mycoplasma mycoides subsp. mycoides	Rosendal, Watson, Valdiviesio-Garcia
Association between physiologic status immune response and respiratory disease in feedlot cattle	Martin, Lumsden, Meek
Relationship between milk immunoglobulin concentrations in early lactation and the incidence of mastitis in current and future	Johnson, Leslie, Saunders, Barnum, Muckle
Molecular analysis of Haemophilus (Actinobacillus Pleuropneumoniae and related organisms)	Macinnes, Rosendal, Remmler, Stryjecki, Edwards, Huber
Post-weaning E. Coli diarrhea: detection of antigens for use in vaccines	Gyles, Wilkie, MacLeod, Huber, Stickland
Investigation of staphylococcus infection in neonatal mink	Hunter, Yager, Prescott
Purification of protective antigens of Rhodococcus equi.	Prescott, Lewis, Machangu, Trachuk-Saad
Development of a coxiella elisa for an epizootiological study of Q Fever infection in Ontario goat and sheep flocks	Lang
Relationship of plasmids to virulence in avian salmonellae	Gyle, Wilke, Huber
Rapid detection of viruses from infected animals using ELISA and monoclonal antibodies	Thorsen, Weninger, Limebeer, Huber, Stryjecki
Interferon sensitivity of selected porcine viruses	Derbyshire
Control of Caseous Lymphadenitis in a commercial dairy goat herd	Menzies, Muckle
A study of the occurrence, characteristics and significance of L-form variants of Staphylococcus aureus in bovine mastitis	Muckle, Menzies, Leslie, Johnston
Role of serum resistance proteins in E. Coli mastitis	Muckle, Nemeth, Johnston, Remmler, Stickland

PROJECT TITLE	RESEARCHER
The biology of porcine interferons	Derbyshire, Limebeer, Stryjicki
Improved antibiotic treatment of bovine mastitis	Prescott
Development of a synthetic vaccine for control of infectious bovine rhinotracheitis.	Thorsen
Development of a DNA probe for diagnosis of porcine parvovirus infection	Johnson, Krell, Huber
Diagnosis of parvovirus, transmissible gastroenteritis virus and rotavirus infections in swine	Johnson, Derbyshire, Hubler, Higgins, Saunders, Lime beer, Stryjecki
Leptospiral abortion in swine	Prescott, Watson, Nicholson, Stickland, Remmler
Host immune response to Chlamydia Psittaci	Shewen
Development of fowlpox virus as a vector for live recombinant poultry virus vaccines	Derbyshire, Krell, Zantinge, Limebeer
Evaluation of a rapid automated bacterial identification/antimicrobial susceptibility testing system	Muckle, Papp, Thackeray
Gut-associated reovirus infections of chickens	Thorsen, Moradian, Weninger, Limebeer, Huber, Stryjecki
The evaluation of "milk checker" as a cow-side test in the detection of bovine mastitis	Barnum
Fertility in Beef Bulls	Johnson, Etherington, Buckrell, Bonnett, Liptrap, Wilton
The prevalence and significance of viral infections of sheep in Ontario	Thorsen, Weninger
A study of acute outbreaks of respiratory disease in horses in Ontario	Willoughby, Huber, Gyles, Carmen, Key, Thorsen, Viel, Staempfli
Clinical Studies	
Immunopathogenesis of bovine ocular squamous cell carcinoma	Stirtzinger, Valli, Livesey
Embryo transfer and superovulation in sheep	Buckrell, Johnson
Porcine embryo culture	Johnson, King, Yamashiro

PROJECT TITLE	RESEARCHER
Single dose pharmacokinetic study of antibiotic penetration into the CSF fluid of normal calves	Staempfli, Jamison, Horney, Black
Clinical research in equine joint disease	Hurtig, Schnurr
Microvascular free skin flaps in the horse	Miller, Horney, Hurtig
Development of cardiac ultrasound techniques in the standardbred horse	O. Grady
Collaborative prospective study of equine post-operative lameness	Pascoe, Dyson
Significance of equine influenza type A-1 and 2 & herpes viral infection on the pathogenesis of chronic small airway disease in light horses	Viel, Valli, Willoughby, Thorsen
Evaluation of systemic effects of topically applied atropine in the horse	Williams, Pascoe, O'Grady
Bovine viral diarrhea/mucosal disease: A study of prevalence and biological activity of the causal virus in infected herds	Baird, Thorsen
Effect of cryopreservation in bisected sheep embryos	Buckrell, Johnson
T cell receptor genes in domestic animals	Croy, Yager, Kruth
Development of biotechnological methods of embryo manipulation for advancement of the embryo transfer industry	Betteridge, Wildeman, Johnson, Croy, Beriault, King, Scodras
An evaluation of the predictive value of an ELISA system for zearalonone and mycotoxins in feedstuff	Wilson, Deen
The possible involvement of relaxin in porcine Hypogalactia	Porter, Norman, McMurray, Wasnidge
Evaluation of a new approach to acid base balance	Viel, Pascoe, Staempfli, Kloeze
Restoration of abduction of the para lysed equine arytenoid cartilage	Viel, Horney, Hulland, Partlow, Ducharme
Hemodynamic responses in anesthetized horses to hypotensive therapy	Dyson
A study of acute outbreaks of respiratory diseases in horses in Ontario	Willoughby, Huber, Gyles, Carmen, Key, Thorsen, Viel, Staempfli

Equine Centre

Clinical research in equine joint disease	Hurtig, Schnurr
Articular cartilage transplantation in the horse	Hurtig, Desjardins, Schnurr
Thrombotic disease in horses: role of antithrombine III	Johnstone, Physick-Sheard
Temporary bilateral occlusion of the common carotid artery	Livesey, Dyson, Atwal
The role of nuclear medicine in the diagnosis of equine lameness	Livesey, Pennock, Willoughby Palmer
The effects of three therapeutic regimes on small intestine viability following hemmorhagic strangulation in the pony	Pascoe, Barker, Grovum
The role of the fetus in the hormonal regulation of gestation	Raeside
A study of acute outbreaks of respiratory disease in horses in Ontario	Willoughby, Huber, Gyles, Carmen, Key, Thorsen, Viel, Staempfli
Evaluation of synergistin (R) treatment in foals with experimentally induced bacterial bronchopneumonia	Viel, Staempfli, McDonell, Muckle, Hoffman

Population Medicine

Measurement of estrone sulphate in milk as a method for early confirmation of pregnancy in cows	Raeside, Friendship, Leslie, Sandals,
Embryo transfer and superovulation in sheep	Buckrell, Johnson
Control of lungworm meullerius capillaris in dairy goats by strategic anthelmintic treatment and herd management	Menzie, McGraw
Association between physiologic status immune response and respiratory disease in feedlot cattle.	Martin, Lumsden, Meek
Bovine parvovirus infection: prevalence and other aspects of its epidemiology	Sandals, Meek
Relationship betwen milk immunoglobulin concentrations in early lactation and the incidence of mastitis in current and future	Johnson, Leslie, Saunders, Barnum, Muckle
Relationship of prostaglandin administration histological and bacteriological results of endometrial biopsy & rectal palpation	Etherington, Miller, Johnson, Savage, Liptrap, Martin
Porcine embryo culture	Johnson, King, Yamashiro
Pathogenesis and immunology of bovine parvovirus infection	Sandals, Povey
Methods to decrease fighting in groups of dry sows	Luescher, Friendship, McKeown
Project to identify and improve the health and productivity of Ontario beef cow-calf herd	Martin, Bateman, Meek
Laparoscopic embryo transfer in sheep	Buckrell, Johnson

PROJECT TITLE	RESEARCHER
Isolation, identification and synthesis of estrous phermone in the mare	McKeown, Teal, Luescher
Endocrinology of gestation in the mare	Raeside, Savage, Renaud
Study of the effect of a synthetic prostaglandin, fenprostalene on ovulation control and subsequent luteal development in a mare	Savage, Liptrap
Eperythrozoa and stillbirth relationships in swine	Wilson, Friendship
Estrous synchronization in dairy heifers: comparison of pregnancy rates at timed insemination with cloprostenol or norgestomet	Bateman, Grieve, Menzies
Leg weakness affecting breeding-age swine: an observational study	Friendship, Wilson, Dewey
Assessment of a commercially available enzyme immuno-assay to determine post-partum milk progresterone values in dairy cows	Etherington, Walton, Johnson, Leslie
Effect of cryopreservation on bisected sheep embryos.	Buckrell, Johnson
Study of the effect of a microcomputer based management system on dairy herd performance	Menzies, Etherington, Leslie, Martin, Meek
Tail tip necrosis in beef cattle	Luescher, Wilcock, McKeown, Meek
Control of Caseous Lymphadenitis in a commercial dairy goat herd	Menzies, Muckle
The sensitivity and specificity of cowside milk progesterone tests	Leslie, Walton, Etherington
A study of the occurrence, characteristics and significance of L-form variants of staphylococcus aureus in bovine mastitis	Muckle, Menzies, Leslie, Johnston
Prostaglandin treatment of subestrus, cystic ovarian degeneration and cyclicity following superovulation in dairy cattle	Leslie, Etherington
An epidemiological study of paratuberculosis in Ontario dairy cattle	Meek, Martin
Evaluation of long acting and conventional oxytetracycline for therapy of feedlot respiratory disease	Bateman, Martin
A study of morbidity and mortality in yearling feedlot cattle	Martin, Bateman
The relationship between bulk milk culture results, management factors used in mastitis control, and herd prevalence of mastitis	Leslie, Martin, Meek, Muckle
Leg weakness affecting breeding age swine	Friendship, Wilson, Dewey
The prevalence of Salmonella on dairy farms in Ontario	McEwen
An epidemiological study of antibiotic residues in bulk milk from Ontario dairy farms	McEwen, Black, Meek, Elliott

PROJECT TITLE	RESEARCHER
Evaluation of cowside ELISA milk progesterone assays as a means of improvement of estrous detection and reproductive performance	Etherington, Walton, Johnson, Leslie
Effects of human chorionic gonadotrophin administered 3 days after breeding on third service conception rates	Leslie, Walton
The effect of environmental influences in intensive confinement systems	Friendship, Luescher, Wilson, Deen, Dewey
Prevention of downgrading losses in turkeys	McEwen, Julian, Barbut, Elliot
A proposal to investigate the economic and biologic efficacy of preconditioning beef calves	Martin, Alves
The use of a GNRH antagonist to delay ovulation in superovulated holstein heifers and its effect on numbers, dev. & morphological quality of embryos	Rieger, Johnson, Walton, Beriault
Fertility in beef bulls	Johnson, Etherington, Buckrell, Bonnett, Liptrap, Wilton
The relationship of various health factors to milk composition and culling in dairy cattle	Valli, Leslie, Godkin, Vernau, Szijavto, Vizi
The use of rapid milk progesterone tests for improved therapy of common reproductive problems and in embryo transfer programs	Leslie, Etherington, Kelton, Bateman, Godkin, Lissemore, Christie
An evaluation of the predictive value of an ELISA system for zearalonone and mycotoxins in feedstuff	Wilson, Deen
Evaluation of a Pasteurella Haemolytica vaccine/bacterial extract (presponse) for the prevention of UBRD in recently shipped feedlot calves	Bateman
SHEPHERDS - sheep health & productivity study - a project to identify and improve disease & management in Ontario sheep flocks	Menzies, Waltner-Toews, Buckrell, Physick-Sheard, Walton
Cryopreservation of embryos by virification	Johnson, Young
An epidemiological investigation of undifferentiated bovine respiratory disease in large feedlot pen conditions	Meek, Martin, Ribble
Equine vectocardiography	Physick-Sheard
The development and treatment of stereotypies in horses	Luescher, McKeown

ECONOMICS

Forecasting beef and hog prices	Martin, Van Duren
A price forecasting mechanism for the Canadian beef-pork sector	Martin, Van Duren
The use and development of econometric models for agricultural commodities	Meilke

PROJECT TITLE	RESEARCHER
Farm structure and performance in Canada	Brinkman
Evaluation of the productivity of Ontario agricultural research phase II	Brinkman
Marketing strategies for Ontario grain producers	Martin
Marketing strategies for Ontario livestock operations	Martin
Input demands in the Canadian meat processing industry	Goddard
Analysis of business strategies for local grain elevators and farm supply outlets	Harling
Evaluation of feedgrain marketing facilities for Timiskaming	Goddard
The economics of shopping and bargaining in the purchase of production inputs	Funk
Analysis of government intervention affecting Ontario's food processing industries	Harling
The determination and impact of government policy interventions in world agriculture	De Gorter, Sarker
The effectiveness of advertising milk in Ontario	Goddard, Alpen
The quantitative assessment of domestic and international trade policies	Meilke, Kahn, Moreau, Martin, Van Duren, Sarker
Economics of technological changes in the livestock sector	Fox, Oxley

ENGINEERING

PROJECT TITLE	RESEARCHER
Economics of biogas and protein for livestock feeding derived from livestock manures	Stonehouse, Driver, Young
Analysis of corn grain yield in relation to tillage and climatic conditions	Farazdaghi, Miller
Measurement of floor and wall pressures in a bottom-unloading farm silo	Jofriet, Vogel, Nege, Quat
Development of an on-farm silage separating (fractionating) unit	Bilanski, Mowat
Toxic gas formation in silo fermentations	Meiering
The stability of sprayed-on polyurethane insulation in steel-clad fruit and vegetable storage buildings	Jofriet, Laking
Natural ventilation	Iwaniw, Donaghy, Ogilvie, Clarke, Hutchins
Heat exchangers and ventilation	Ogilvie, Iwaniw, Pavliak, Jordan
Soil tool geometrics and physical properties of soils	Lee
Development of a microcomputer-based grain storage control system	Otten
Economics of manure-handling systems for Ontario hog enterprises	Stonehouse, Clark, Van Vuren
Design of farm building components	Negi
Peanut drying and quality control using microwaves	Otten, St. John
Hemicellulose utilization by yeasts: bioconversion of D-Xylose to ethanol	Lee
Bunker silo wall loads	Jofriet, Zhad, Vogel
Development of an on-farm alfalfa separating (fractionating) unit.	Bilanski, Mowat, Mkomwa, Vogel
Heat processing alfalfa while drying to increase its nitrogen availability to livestock	Bilanski, Mowat, Yiljep, Vogel

FIELD CROPS

Grain

PROJECT TITLE	RESEARCHER
Ear mold and mycotoxins in corn	Jones, Woolner
Development and evaluation of corn breeding techniques	Kannenberg, McKillop, Afele, Dowling, Chakravrty
Evaluation of corn hybrids	Kannenberg, Woolner
Development and improvement of corn breeding populations and inbreds	Kannenberg, Sen, Dhalival, Kermali, Dowling, Chakravarty, Woolner
Effects of crop sequence on soil structure, stability and productivity	Vyn, Wichers, Janovicek
Effects of hybrid selection and management on grain corn quality	Vyn, Wichers
Effects of tillage systems and wheel traffic on soil structure and corn response	Vyn, Stewart, Wichers
Production studies on barley and oats	Gamble, Peppard
Cytogenetic studies in cereals	Kasha, Hunt, Reinbergs, Oro, Falk, Du, Cober
Crop improvement through plant cell and tissue culture	Kasha, Oro
Testing new improved varieties of cereals	Hunt, Falk, Szlavnics, Wood, Johnson, Meatherall, Madrid
Haploid production and utilization in cereals	Kasha, Reinbergs, Oro, Falk, Hunt
Winterhardiness of winter cerals	McKersie, Hunt, Kendall, Gregario, Anandarajah
Breeding new and improved varieties of winter and spring wheats	Hunt, Sprague, Szlavnics, Lin, Verwur

PROJECT TITLE	RESEARCHER
Breeding improved varieties of spring barley	Falk, Reinbergs, Kasha, Anderson, Edgington, Ho, Boyd, Louter, Simion, Meatherall, Madrid
Breeding improved varieties of winter barley	Falk, Smid, Bridger, Madrid
Breeding improved varieties of oats	Falk, Burrows, Reinbergs, Meatherall, Madrid
Breeding improved varieties of winter triticale	Hunt, Mizier
Microspore culture in wheat	Kasha
Improvements of oat anther culture	Falk, Polsoni
Winterhardiness in cereals	McKersie, Yang, Barclay, Gregorio

Forages

Seed production studies in forage and turf species	Gamble, Raimbault, Martins, Peppard
Selection for forage yield in grasses	Christie, Martin
Forage cultivar evaluation	Christie, Bowley, Martin
Winterhardiness of alfalfa	McKersie, Bowley, Lai, Gregario, Gusse
Protein degradation in ensiled alfalfa forage	McKersie
A legume ideotype for grain crop sod-seeding	Clark, MacDonald, Hall
Breeding for improved quality in perennial legumes	Bowley, McKersie, Christie
Increasing seed yield in birdsfoot trefoil	Bowley
Interspecific interactions in breeding forage crops	Bowley, Hancock
Introgressive hybridization of forage legume species	Bowley
Application of tissue culture technology to forage legumes	Pauls, Bowley, Brazalot
Determinants of drying in forage legumes	Clark
Annual and perennial pasture species	Clark, Mares-Martins
Somatic embryogenesis in alfalfa	McKersie
Development of hybrid alfalfa	McKersie, Bowley, Bewley, Hancock, Gregorio
Productivity of beef cattle on pasture	Clark, Buchanan-Smith, McDonald
Legumes for plowdown	Christie, Ames-Gottfred, Martin

PROJECT TITLE	RESEARCHER
Alfalfa - selection for winterhardiness	Christie, Martin, Posh
Alfalfa seed production	Christie, Kucyk
Improvement of forage quality in alfalfa	Christie, Martin
Diseases of alfalfa	Christie, Boland, Miller, Yu, Papadoupolos, Martin
The relative importance of disease and insect control on alfalfa production	Sheard, Boland, Ellis
Gametophytic self-incompatibility	Bowley, Eastman, Clarkson, Hancock
Forage legume - vesicular asbuscular mycorrhizal associations	Bowley, Peterson, Hancock, Lackie
Population development of forage legumes	Bowley, Hancock, Clarkson
Development of DNA probes for the identification and quantification of Verticillium Albo-Atrum and Verticillium Dahliae in alfalfa	Robb

Protein and Oilseed

Common bean breeding and genetics	Michaels, Tinker, Scott, Smith, Krusky
Seed vigour of soybean and fieldbean	Gamble, Zetina, Davies, Peppard
Soybean breeding and evaluation	Tanner, Rennie, Saindon, Gostovic, Muscat, Thorpe
New management systems for common bean production	Michaels, Smith, Krusky
Peanut breeding and genetics	Michaels, Tanner, Syamasonta, Smith
TI plasmid-mediated gene transfer	Wildeman, Nazar
Development of microspore mutagenisis/ in vitro selection system for brassica oilseed species	Beversdorf
Flow cytometric sorting of protoplast fusion products	Pauls, Brazalot
Effect of genotype and environment on quality aspects of soybeans and rapeseed	Tanner, Hume, Banks, Chen, Rennie, Beversdorf, Montminy, Watson
Spring rapeseed breeding and evaluation	Beversdorf, Hume, Banks, Kott, Charne, Duke, Gostovic, Montminy

PROJECT TITLE	RESEARCHER
Winter rapeseed breeding and evaluation	Beversdorf, Kott, Hume, Gostovic, Montminy
Agrobacterium mediated transformation of haploid B. Napus	Pauls, Ellis, Powell
Improving soybean nitrogen fixation and production efficiency	Hume, Pararajasingham, Feindel, Blair, Chu, Frauley, Kutchaw, Yu
Spring oilseed testing and management	Hume, McNalty, Alam, Chu, Yu, Watson
Winter canola testing and management	Hume, McNalty, Chu, Yu, Watson

FOOD AND FOOD QUALITY

Metabolic activities of bacteria and microorganisms in relation to the quality of dairy and food products	Cunningham
Controlled Atmosphere (CA) storage of apples	Lougheed, Murr, Proctor, Wiley
Controlled Atmosphere storage of vegetables	Lougheed, Murr, Wiley, Perkin
Microbial utilization of liquid agricultural and industrial carbohydrate wastes from food & fermentation industries.	Cunningham
Microorganisms as potential food sources (single cell protein) for human food supplementation	Cunningham
An investigation of the major factors influencing beef tenderness	Stanley, Johnson
Moisture mobility, product quality and functionality of meat emulsions due to binders extenders and meats	Mittal, Usborne, Cprreoa, Ausma
Characterization and nutritional assessment of oilseeds and processed vegetable oils from newly developed varieties of Ont. canola	Holub, Wilson
The role of water soluble pentosans in the process of soft wheat flour chlorination	Rasper
The bioavailability of ZN, CU, FE and MN from extended meat foods	Bettger
Significance of individual sugars to chipping quality of stored potatoes	Yada, Stanley, Lougheed, Coffin, Barichello, Atin
Nutritional evaluation of heated canola oil	Alexander
Post-harvest nutrient retention in Ontario-grown vegetables	Alexander, Lougheed
Physico-chemical changes of milk proteins in heated milk systems on the rheological properties of yogurt	Kakuda
Bio-fuel fermentation control	Meiering, Ausma
Use of fiber optics and computer-operated systems in the optimization of quality in meat products	Swatland
Lipid oxidation in mechanically deboned poultry meat	Kakuda
Elucidation of cold temperature processability of potatoes (Solanum spp.)	Yada, Grodzinkski, Coffin
Warm carcass grading and quality evaluation of beef carcasses	Usborne, Gullett, Reist
Investigation of the hard-to-cook defect in Ontario white beans	Stanley, Michaels
Effect of freezing conditions on quality of ground meat	Usborne, Mittal, Hanenian, Ausma
The use of MDPM in further processed products	Barbut
Chill-injury in Ontario tomatoes	Stanley, Yada, Marangoni, Murr, Thompson, Beckerson
Sensory evaluation and consumer acceptance of restructure beef steak	Gullett, Bernal, Roth, Reist
Sensory profile technique for predicting consumer acceptance of frozen peas	Gullett, Sanford, Roth
Evening primrose oils as lipid source in 'humanized' infant formula	Glanville
A new cheese for export markets	Hill, Deman, Kendall
Manufacture of cheddar cheese from ultrafiltered milk	Hill, Ferrier, Pabari, Sharma, Hager
Thermal precipitation of proteins from milk whey blends	Hill, Hunter, Harwalkar

HORTICULTURAL CROPS

Fruit

Responses of fruit crops to environmental factors	Ormrod
Effect of pre-harvest and post-harvest factors upon the physiology and regulation of fruit ripening	Murr, Lougheed, Kristof
Production techniques for tree fruits, particularly apple	Proctor, Lougheed, Louttit
Effect of management scheme on yield and fruit quality of red raspberry	Sullivan, Van Schyndel
Raspberry breeding	Sullivan, Van Schyndel
Strawberry breeding	Sullivan, Sangiacomo, Van Schyndel
Strawberry management	Sullivan, Cherciutte, Van Schyndel

PROJECT TITLE	RESEARCHER
Vegetables	
Factors influencing the incidence of black speck in cauliflower curds	Riekels
Cultural studies with field and greenhouse vegetables	Tsujita
Plastic mulch trials	Tiessen
Responses of vegetable crops to environmental factors	Ormrod
Breeding of rutabagas and asparagus	Harney, Nonnecke, Souza-Machado, Tiessen
Breeding and evaluating potato varieties for Ontario	Coffin, Keenan
Asparagus variety improvement and cultural practices	Tiessen, Harney, Peterson
Rutabaga seed production	Nonnecke, Kramp
Significance of individual sugars to chipping quality of stored potatoes	Yada, Stanley, Coffin
Scheduling irrigation for optimum water use and yield of potatoes	Brown, Dixon, Coffin, Coffey, Singh
Asparagus variety improvement and cultural practices	Proctor, Harney, Peterson, Jones, Butler, Jamieson, Wedel
Incorporation of turnip mosiac virus resistance into rutabaga/rutabaga breeding	Shattuck, Bozic
Responses of vegetable crops to industrial pollutant stress	Ormrod, Marie, Pyear, Church
Ornamentals	
Cultural studies with field and greenhouse vegetables	Tsujita
Responses of ornamental crops to environmental factors	Ormrod
Integrating greenhouse control of lighting, C02 and temperature for increased plant productivity	Grodzinski
Breeding and mass in vitro propagation of flowering ornamentals	Harney, Nonnecke
Production and handling practices influencing keeping quality of cut roses	Tsujita, Murr, Grodzinski
Physical, chemical & environmental parameters in container growing	Lumis, Struger
The influence of cultural practice on landscape trees	Lumis, Struger

PROJECT TITLE	RESEARCHER
Agroforestry	
Intercropping of black walnut with agricultural crops in Southern Ontario	Gordon
Turfgrass	
Insect pests of turfgrass	Sears
Integrated management of turfgrass disease	Burpee, Goodman, Riddle
Herbicide and plant growth regulator research in turf	Hall, Stephenson, Christianson
Competitive ability of turfgrasses	Eggens, Carey
Turfgrass cultivar evaluation	Eggens, Carey
Turf renovation	Eggens, Carey
PEST MANAGEMENT AND DISEASE CONTROL	
Weeds	
Industrial oils and waxes from weeds	Alex, Rattray
Breeding of rutabagas and asparagus	Harney, Nonnecke, Souza-Machado, Tiessen
Competition among weed species and crop plants	Alex
Biological control of weeds	Alex
Evaluation of new herbicides and combinations of herbicides for control of annual and perennial weeds in field crops	Anderson, Swanton, Harris, Chandler
Weed control in established stands of alfalfa, birdsfoot trefoil and legume grass mixture	Anderson, Swanton, Harris
Weed control in fruit crops	Cain
Weed control in ornamental and woody crop situations	Cain
Physiology and biochemistry of herbicide selectivity in plants	Stephenson, Ekler, Bowhey
Plant growth regulating properties of triadimefon	Fletcher
Environmental fate of herbicides and other pesticides	Stephenson, Hall, Bowhey
Weed control in conservation tillage	Swanton, Chandler
Berry crop weed control	Cain
Weed control in ornamentals	Cain
Evaluation of new herbicide treatement for control of weeds in field crops	Anderson, Swanton, Harris, Chandler

PROJECT TITLE	RESEARCHER

Insects

Control experiments for pests of forage and field crops	Ellis, Beattie
Threshold limits in pest control	Ellis, Beattie
Biology, ecology and control of the onion maggot	McEwen
Pesticides for minor crops	McIver, Ritcey
Pest diagnostic and advisory clinic	Wukasch, Kelly
Biology of orchard insects	Laing, Xuegi, Zheyong, Fisher, Wang, Greenville
Biology of pests on forage and cereal crops	Ellis
Biosystematics of decay-related diptera	Marshall, Wheeler
Bionomics of Hemiptera parasitoids (Phasiinae: Tachinidae)	Marshall, Lippert
Arthropod & vertebrate pest control as related to livestock & poultry	Surgeoner, Langtrigner, Glofecheski, Sach
Insect pests of vegetable crops	Sears
The relative importance of disease and insect control on alfalfa production	Sheard, Boland, Ellis
Biology and control of insects affecting the production of forage and field crops	Ellis, MacDonald, Stewen, Beattie

Diseases

Virus disease of the commercial tomato crop	MacNeill
Fungal parasites of nematodes	Barron, Szijarto
Systemic fungicides: efficacy for control of cereal diseases	Edgington
Systemic fungicides - efficacy for control of vegetable diseases	Edgington
The development of pathogenic races in Erysiphe Graminis Tritici the cause of powdery mildew of wheat	MacNeill
Management of gray mold in strawberries	Sutton
Disease management practices for improved productivity of winter wheat	Sutton, Wright, James
Biology and control of low-temperature-tolerant plant pathogenic fungi	Burpee, Lawton
Monoclonal antibodies to pathogenesis - related enzymes in tomato	Ellis
Diseases of alfalfa	Christie, Boland, Martin
The relative importance of disease and insect control on alfalfa production	Sheard, Boland, Ellis
Management of white mould in white beans	Hall, Phillips
Biocontrol of grey mould fruit rot of Strawberries	Sutton, Jones, Gang

PROJECT TITLE	RESEARCHER

SOIL, WATER, AND WASTE MANAGEMENT

Agrometeorology

Acquisition and compilation of agroclimatological data	King, Gillespie, Fuents, Sweetman
Assessment of the potential for increasing yields of field corn with irrigation	Brown
Investigation of planetary boundary layer models to estimate regional-scale climates	Gillespie, Thurtell, Kidd, Barr
Measurement and estimation of crop microclimates for pest management	Gillespie, Kidd, Sweetman
Microclimatic influences on water status of dead plant tissue	Gillespie, Thurtell
Effects of elevated atmospheric C02 concentration on yield and water use efficiency of crops in the field	King, Kidd, Fuentes, Sweetman
Effects of environmental and physiological factors on net photosynthesis of field crops	King, Kidd, Sweetman
Crop canopy diffusion	Thurtell, Kidd, Edwards, Ping, Sweetman
Influence of root systems on water availability and yield	Thurtell, Kidd, Berard, Sweetman
Scheduling irrigation for optimum water use and yield of potatoes	Brown, Dixon, Coffin, Coffey, Singh

Streamwater Management

Effect of land drainage on streamflow	Irwin, Whiteley
The effect of agricultural activities on levels of N03-N and related constituents in ground water	Whiteley
A mathematical model for the investigation of tube drainage effects on surface and subsurface streamflow components	Stammers
Control of soil erosion and associated water pollution	Dickinson, Rudra
Riparian forest plantations for wood production, soil erosion control and stream rehabilitation	Kaushik, Gordon

Land Use

Impact of farm tenancy on agricultural land use	Van Vuuren
The frequency/magnitude of wind erosion & relationship to soil type & agri-production systems in Southern Ontario	Nickling
Land rating for agriculture	Smit, Ludlow, Kristjanson, Smithers

PROJECT TITLE	RESEARCHER
Development of a rating system for soil compaction susceptability	McBride
Describe quantity & quality of drainable water from land use managment and climatic conditions in southern Ontario	Rudra, Dickinson
Regional climate/soil/water relationships for drainage	Chisholm
Drainage versus preservation of wetlands	Van Vuuren
Impact of taxation on adopting subsurface drainage	Van Vuuren
Development of an index of soil quality	Protz, McCabe, Dickson
Development of a rating system to evaluate agricultural land at the local level - phase III	Hilts, McBride, Brown
Socio-economic factors in local land rating	Rodd, Penfold, Pinto
The economics of conservation tillage in Southwestern Ontario	Fox, Dickson
An evaluation of the economic viability of rehabilitating severely-eroded croplands	Stonehouse, McBride, Amanor-Boadu
Developing a local land evaluation system	Taylor, Brown

Crop and Soil Management

Forage systems as nitrogen sources in crop production	Sheard
Interaction of soil drainage, species and plant nutrition	Sheard
Phosphorus and potassium requirements for alfalfa production	Sheard
A maximum alfalfa yield project for Ontario	Sheard
Microbial activities in agricultural soils	Trevors
Development of methodology to characterize some physical properties of soils under different tillage treatments	Kay, Groenevelt,
Effect of erosion on soil properties and corn yield	Groenevelt
Soil test calibration for the major field crops	Sheard
Boron in Ontario soils	Evans
Development and evaluation of methods for prediction of macro and micronutrient requirements of crops	Bates
Use of sewage sludge on agricultural land with emphasis on plant availability of heavy metals	Bates
Water and chemical transport in soils	Elrick
Fertility requirements for maximum corn yield at Elora	Miller, Mitchell, Lushen, Barry
Describe quantity and quality of drainable water from land use management and climatic conditions in Southern Ontario	Rudra, Dickinson, Tan

PROJECT TITLE	RESEARCHER
Charge characteristics of Ontario soils	Evans
Nitrogen fertilizer use efficiency under conservation tillage system	Kachanowski
The relative importance of disease and insect control on alfalfa production	Sheard, Boland, Ellis
Protein enhancement winter wheat through nitrogen use	Sheard
Evaluation of soil additives for erosion control	Groenevelt, Mott
Evaluation of a nitrogen soil test and the fate of fall applied N.	Beauchamp, Farquharson, Kachanowski
Identification of soil management and cropping practices which sustain the capability of a soil to accept, cycle and store organic matter	Voroney, Wilson
Crop residue management and phytotoxin effects under conservation tillage	Voroney, Wilson
Methods of application of fertilizer at planting for corn in conservation tillage systems	Miller, Mitchell, Lu, Lobb
Agroeconomics of hybrid poplar in Eastern Ontario	Phillips
Energy utilization in the Ontario agri-food systems	Phillips
A study of the debt carrying capacity of Ontario farms	Clark
Planning minimum risk market hedging and production strategies on cash crop beef feedlot farms in Southwestern Ontario	Driver, Clark, Martin
Impacts of tillage and crop rotation combinations on land degradation and economic viability of the farm firm	Stonehouse, Kay, Van Vuuren, Vyn
Socio-economic impact of acid rain on agriculture in Ontario: a review of the literature	Phillips
An investigation into the cost estimation and allocation problems of developing credible database systems for Cdn. dairy industry	Driver, Menzie, Stonehouse
Production opportunities in non-prime lands	Smit, Bray
An assessment of the minos mathematical programming algorithem for modelling farm firms	Fox
An initial assessment of the impact of airborne pollutants on the agriculture of Southwestern Ontario	Phillips
Economics of manure-handling systems for Ontario hog enterprises	Stonehouse, Clark, Van Vuuren
A farm-level economic assessment of alternative methods of implementing policies to induce soil conservation	Stonehouse, Rodd, Brinkman
Identification of critical success factors for farm managers in Ontario	Fox, Harling

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